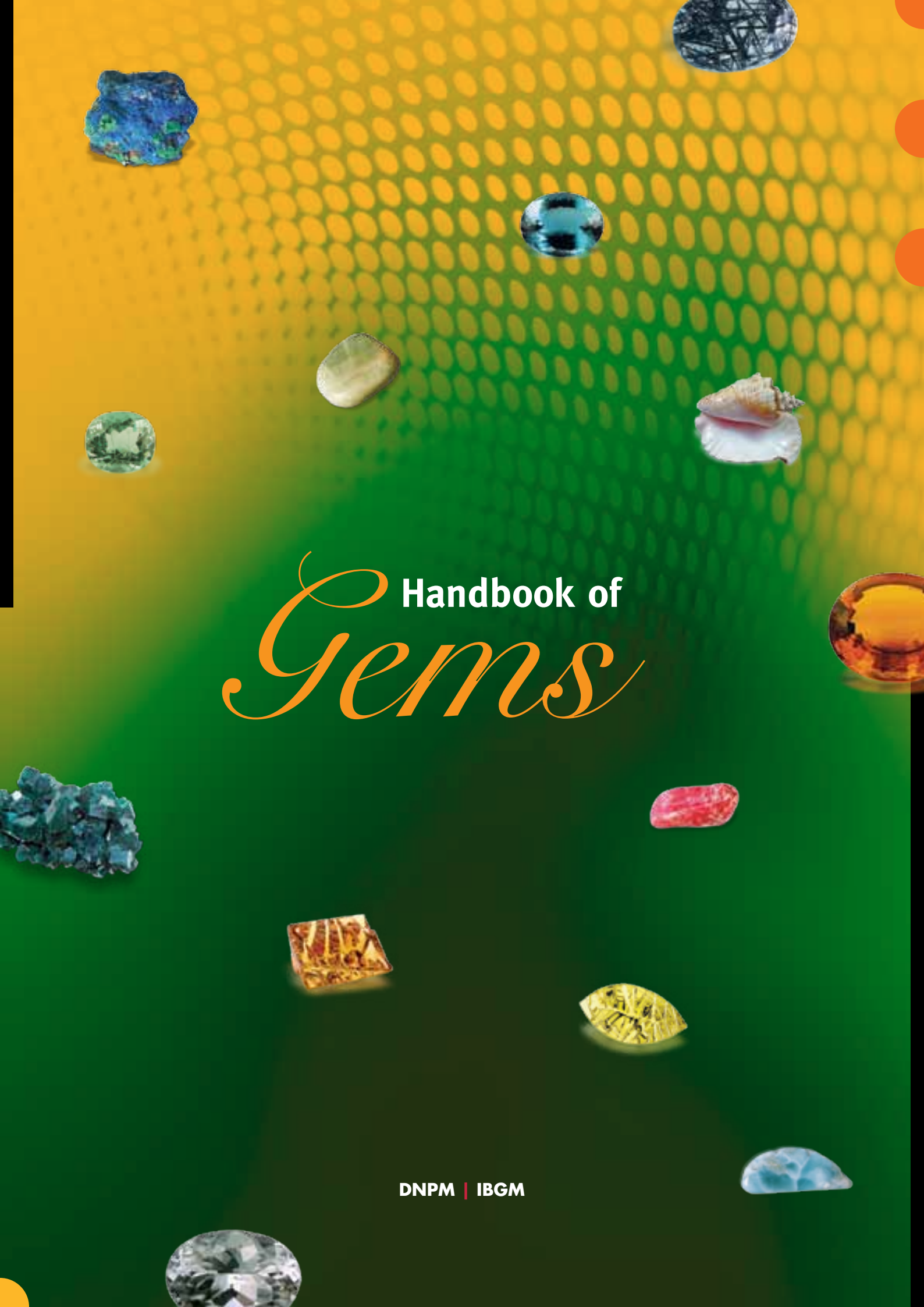

Handbook of Gems

DNPM | IBGM

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FEDERATIVE REPUBLIC OF BRAZIL

MINISTRY OF MINES AND ENERGY

National Department of Mineral Production

Secretariat of Geology, Mining and Mineral Transformation

Handbook of *Gems*

IBGM
BRAZILIAN GEMS & JEWELLERY TRADE ASSOCIATION

IBGM'S GEMOLOGICAL LABORATORIES NETWORK

DNPM
National Department of Mineral Production

PARTNERSHIP

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MORE DETAILS ABOUT THE BRAZILIAN GEMS AND JEWELLERY SECTOR
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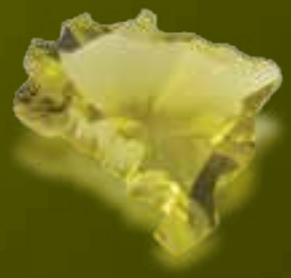


EDITOR'S NOTE

In this new edition of the **Handbook of Gems** we have included two categories: synthetic gems and imitations. Plus, we have incorporated microphotographs of typical inclusions for the most important synthetic gems, in order to help identify them. We have also presented pictures of kimberlites and rough diamonds from brazilian sources, in various colors and habits.

It's been summarized in this publication the information with respect to the most commonly found and traded gems in Brazil. Such information is generally described in documents, technical norms or publications of difficult access to the general public of interest – whether professionals or simply admirers of gems and jewellery.

Firstly, we present information about the definitions, terminology and rules for utilization of the gems.

Subsequently, we describe 158 gems, separately by the usual categories: organic, unusual, synthetic, artificial and imitations, including descriptions for their physical, chemical and optical properties. Everything has been richly illustrated by high-quality colored pictures to reveal in greater detail the beauty of the gems.

In order to facilitate the average reader's search, the subject index of gems includes, besides, the most well-known names in the market.

The attachments from sections I to IV present, respectively: the Brazilian gemological and diamondiferous maps; the natural gemological materials, the synthetic and artificial gems; the products found in the sector; the mineralogical groups and the mineral species of interest in gemology.

Finally, we provide all the contacts of DNPM's regional districts and the IBGM's gemological laboratories. They will be at the general public's disposal to answer questions or, in case of the latter, to provide identification reports for gems.

PRESENTATION

In order to incorporate the constant improvements in our work, in such a way as to better satisfy our goals and clients, we have the pleasure to present the fourth edition of the **Handbook of Gems**, a result from the partnership between the National Department of Mineral Production (DNPM) and the Brazilian Gems and Jewellery Trade Association (IBGM). This edition marks the passing of the 75 years of DNPM's existence.

In this edition we sought to incorporate various improvements, such as the inclusion of 45 new gems, with their respective specifications and pictures, and improvements to the text as well. Another improvement is that the Handbook is now available in a digitalized format to be downloaded from our websites or run from our CDs, both in English and Portuguese. And thereby we aim to disclose our vast gemological assets both in Brazil and abroad.

Therefore, this publication covers practically the entire universe of gems, by presenting the technical and physical information with respect to 158 gems and further strengthening its role of reference material to researchers.

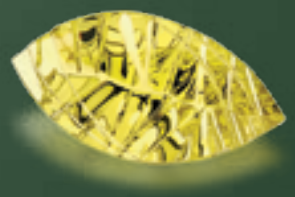
We pay our compliments to all those who have made possible the development of this Handbook. We reassert our confidence that it will keep satisfying the demands of its destined public, particularly gemologists, cutters, experts, teachers and entrepreneurs.

Brasília, October, 2009

Miguel Antônio Cedraz Nery
DNPM'S GENERAL DIRECTOR

Hécliton Santini Henriques
IBGM'S PRESIDENT

SUMMARY



PREFACE

The **Handbook of Gems** is a result and product from the partnership established and renewed for the fourth time in a row – 1998, 2001, 2005 and 2009 – between the National Department of Mineral Production (DNPM) and the Brazilian Gems and Jewellery Trade Association (IBGM), based upon the following premise:

"The concept of partnership adopted by the DNPM – in honor to the Technical Cooperation Agreements (ACTs) – lies in the terms of commitment agreed by the legal entities, of public or private nature, in a temporary or permanent way, under the assumption of transversality of actions and convergence of efforts towards the consecution of its institutional goals and established aims. It implies sharing investments, risks, costs and benefits of the goods and services generated, in pursuit of greater efficacy, efficiency and effectivity of the social, economic and environmental results expected from the program Mining and Sustainable Development and its Actions, inserted in the conception of the PPA 2008-2011."

Indeed, in sharing the launching of this 2009 edition of the Handbook of Gems and celebrating its 75th year of existence, the DNPM reasserts its place as the Manager of Brazil's Mineral Assets. It contributes effectively to widen and improve the access to knowledge of the Earth Sciences, particularly gemology, to students, professionals, academics and the Brazilian society.

Antonio Fernando da Silva Rodrigues, *Geologist*
DEVELOPMENT AND MINERAL ECONOMY DIRECTOR | DIDEM
NATIONAL DEPARTMENT OF MINERAL PRODUCTION | DNPM

GEMOLOGICAL MATERIALS

The gemological materials usually found or traded in Brazil have definitions and terminologies which are indicated by specific national and international technical norms established by organisms, such as the ABNT in Brazil or the ISO and the CIBJO in an international level. We found it convenient to gather together and consistently present the main definitions, terminologies, rules for commercial utilization and constant techniques of the aforementioned documents, as described in the following lines:

MAIN DEFINITIONS AND COMMON TERMINOLOGY

The natural gemological materials are those entirely created within nature with no man's interference. They may have inorganic origins, such as minerals and rocks; as well as organic origins, as such as substances provinient of vegetals and animals.

Because of their intrinsic properties (color, luster, rarity, hardness etc), organic or inorganic natural substances are denominated ***natural gems*** if it is mainly used for personal adornment purposes.

Minerals or rocks are denominated ***ornamental materials*** if they are used mainly for collections, sculptures, inside decorations or architectonic purposes.

Synthetic and artificial gemological products are those manufactured by man.

Man-made products with no analogous product in nature are denominated ***artificial gems.***

Synthetic gems are crystallized products which were fabricated by man regardless of any methodology executed. Their physical and chemical properties, as well as crystalline structure, are essentially the same as to those of their natural counterpart gems.

Composite gems are crystalline or amorphous materials, made up of two or more parts assembled by bonding or other artificial methods. Its components may be natural, artificial or synthetic gems, as well as glass.

Coated gems are the ones upon whose surface has been deposited, by crystallization or other means, a thin layer, colored or not, which may be or not of equal chemical composition.

Imitations are products that simulate natural or synthetic gems. They are fabricated by man with the aim to reproduce the optical effect, the color and/or appearance of natural or synthetic gems, without its crystalline structure or any of its chemical and physical properties.

Reconstructed gems are materials produced by man through partial fusion or clustering fragments of gems.

Simulant are either natural, artificial or synthetic gems which, for its appearance (color, luster), simulate natural gems of higher value or fame. For instance, there are colorless zircon, colorless sapphire, cubic zirconia and colorless beryl as diamond simulants. There is also the red spinel as a simulant for ruby and the green tourmaline as a simulant for emerald.

Cultured gemological products are those produced by nature with partial intervention of man. The ***cultured pearl*** is an example of a ***cultured gemological product*** with organic origin.

RULES FOR USING THE DEFINITIONS AND TERMINOLOGY

The names for minerals, gems and other terms must be used properly, especially when written in certificates and commercial, scientific or technical documents. The national and international technical norms – from ABNT, ISO and CIBJO – present the rules that must be respected in naming the gemological materials. The following lines indicate the most important considerations to be taken:

The natural substances and synthetic or artificial products must be denominated in accordance with the definitions and terminologies previously indicated. If these denominations demand complements, they must be written in the same way as the fundamental denomination, as in colors and dimension, avoiding any abbreviation. It must be employed in official and technical scientific publications, in all communication towards the public or in any commercial transaction (advertisements, lables, receipts, other fiscal documents etc.).

Whenever and wherever there is an exhibit of natural, synthetic or artificial gems as well as the jewellery fabricated with them, it must be clearly identified each article and material used or exposed.

As for the jewels conceived with two or more gems, natural or not, these must be accompanied by a document that describes the nature, quantity and mass of the gems, as well as the precious metal employed in its fabrication with its karatage and weight.

It must be avoided the use of names for minerals or gems to describe attributes of color. For instance: spinel-ruby and alexandrite-type sapphire.

Gems that have nothing in common with one another must not have their names combined. For instance: the yellow quartz can't be described as "topaz-quartz", "citrine-topaz" or "topaz-citrine". It's recommended only names like "citrine" and "yellow quartz".

The term ***brilliant***, with no further description of the material involved, must be employed only with reference to round diamonds with brilliant cut.

It must be avoided the usage of names for shapes and cut styles to designate a gem, with the exception of the term ***brilliant*** as previously indicated. Indications with regard to the shape and the cut styles of gems must be referred to as in the following examples: "brilliant-cut sapphire". "rose-cut diamond". "navette-shape emerald", "baguette-shape emerald", "emerald-cut ruby", "pear-shape tourmaline" and "cabochon-cut sapphire" etc.

Colored gems or gems that have been colored by chemical or physical-chemical means must be categorized as "treated gems". The nature of the treatment to which the gem has been subjected must always be specified along with the gem's name with equal relevance and no ambiguity, as well as the commercial documents. In this case we can include:

A] gems whose color has been altered by irradiation or bombardment.
ex: irradiated diamond, bombarded topaz, irradiated topaz;

B] gems that have been coated.
ex: coated emerald;

C] gems treated by a diffusion process
ex: sapphire and ruby with diffusion treatment

D] gems whose color has been altered by chemical treatment
ex: dyed opal, dyed agate

E] gems whose inclusions have been removed or treated with laser or other means, and gems whose cavities have been filled with glass or similar products. Such gems must always be labeled with equal relevance and no ambiguity as "with removed inclusions" or "with filled cavities",

The gems that have become radioactive, due to the treatment to which they were submitted, must not be commercialized or used for as long as their acquired radioactivity is in course.

All the artificially modified gems must be designed as such without any ambiguity in order to simulate the color or appearance of another gem. For example, the blue-dyed jasper.

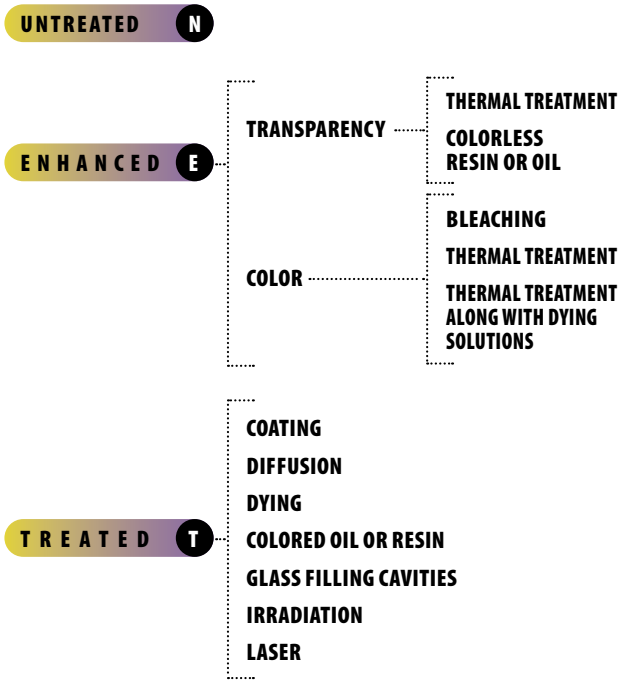
There are kinds of treatment regarded as established commercial practices which find acceptance in the international market , such as:

- The gem's color permanent transformation by means of thermal treatment. For example: beryl (aquamarine, morganite); corundum (sapphire, ruby); topaz (pink); tourmaline (all colors); zoisite (tanzanite).
- The gem's color permanent transformation by means of thermal treatment along with the effect of acids and dying solutions. For example: green agate, blue agate.
- Bleaching of ivory, coral and pearls.
- The treatment for emerald, rubellite, corundum and other gems with paraffin, oily substances, colorless oil, colorless resins like opticon and similar substances is a well-established practice generally accepted by the market. The complete information on the treatment to which the gem was submitted is mandatory.

The International Colored Gemstone Association (ICA) is the main organization to gather the most important producers and exporters of colored gems.

It holds that its associates must provide a complete description for their sales documents and gems' certificates, the codification characters as presented in the NET Chart of gems, or the description for the treatment to which the gems were submitted in order to highlight their transparency, color and/or removal or fillings of inclusions.

N.E.T CHART OF GEMS



On the other hand, it shall be avoided the use of fancy, brand or manufacturer´s names for treated or artificially coloured gems, since such names are misleading. For example: the prasiolite (a green-coloured amethyst due to thermal treatment), since it may be confused with the natural-colour prasiolite.

Gems that present special optical phenomena such as "chatoyancy" or "cat's-eye effect" shall be described by their mineral or variety names, along with the term cat's-eye (ex: cat's-eye tourmaline). Only the chrysoberyl variety may be named just as "cats'-eye", since it presents the refferred optical phenomenon. Likewise, gems presenting "star effect" (asterism) may be described as star gems or asteriated gems (ex: star-sapphire and star-ruby), as long as the gem's name remains.

The term "semi precious" shall be avoided, rather it must be replaced for the term "precious", with the exception of legal or commercial requirements.

The term ***gem*** shall not be used solely, for any substance obtained through entirely or partially man-induced crystallization, regardless of the utilized materials or methods. The substance obtained this way shall be described for its corresponding gem name, immediately followed by the word ***synthetic, artificial or cultured.***

Any qualifying adjective other than synthetic, artificial, coated or cultured shall be avoided to describe products obtained through entire or partial man-induced crystallization. The manufacturer's name or brand may be informed (added). Ex: Chatham synthetic emerald, Gilson synthetic emerald, Kashan synthetic ruby.

It shall be avoided the use of expressions like or similar to Chatham emerald, Gilson emerald, Linde emerald, Chatham-created emerald, Gilson-created emerald or Linde-created emerald, as well as the words ***production, reproduction, reply etc.***

The terms noble, orient, authentic, genuine, fine, real, superior, pure or any other alike, shall be abolished for being inadequate to designate gemological varieties.

Synthetic, artificial, imitation, cultured and other such terms shall be placed with equal relevance and no ambiguity alongside the correct name for the material (ex: synthetic ruby and synthetic diamond). It shall be avoided any possibility that this material could be confused with any natural material. If appropriate, information about colour may also be added (ex: synthetic blue spinel).

Artificially crystallized products of which no natural corresponding material is known shall be designated by their fancy or chemical names, followed by the word ***artificial*** in parenthesis. Ex: fabulite (artificial) or strontium titanate (artificial), linobate (artificial) or lithium niobate (artificial), cubic zirconia (artificial), YAG (artificial) or yttrium aluminate.

The terms "doublet", "triplet" or others alike shall be used to describe double and triple gems, as well as other composite gemstones, whether they're made up of two or more distinct parts, whether they're assembled by any chemical or physical process. The terms doublet and triplet shall be immediately followed by the names of their components from the upper towards the lower layer. Ex: A doublet, which the upper part is a garnet and the lower part is blue glass, shall be named garnet-glass doublet instead of garnet doublet.

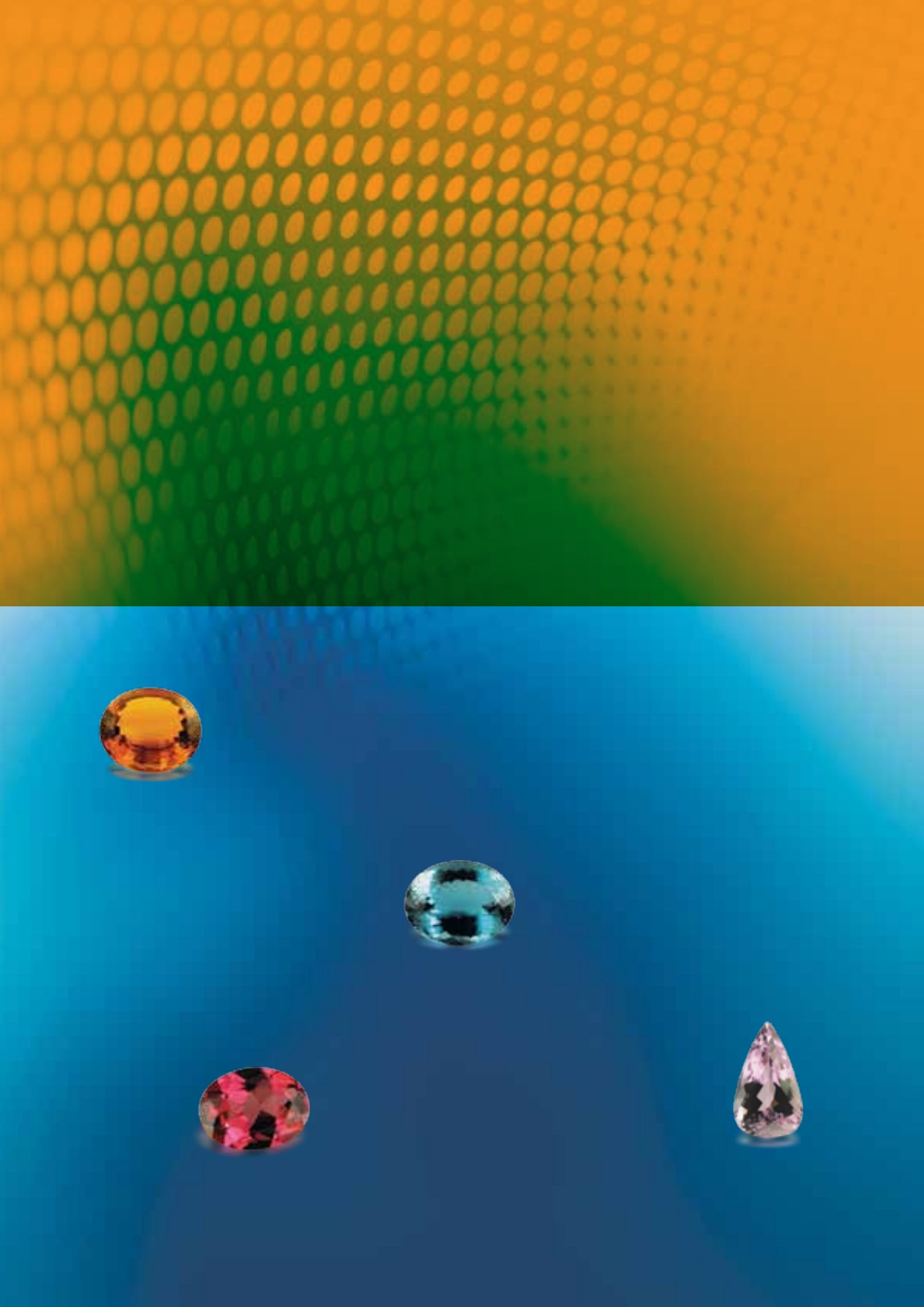
The products defined as imitations shall be clearly described, with equal relevance and no ambiguity, by their material correct names. Ex: green glass, blue acrylic.

It shall be avoided the use of words such as reproduction, reply, high-class, scientific, or similar terms to describe, identify or refer to any imitation, as long as these words may cause the public to misunderstand the real nature of the material.

It shall not be used registered brands or fancy names that possess any similarity (complete, partial and/or allusive) with the writing or pronunciation of the gem's name or any organic substances. Ex: diamite, diamonair, diamondite, opaline, emeraldite.

The indication of ***mass (weight)*** for gems in their rough state is expressed in terms of grams for commercialization purposes. After cutting, it is stated as metric carat, usually known simply as carat, which equals 0,200 g. With the exception of the diamond, whose mass (weight) is expressed in carats, whether in its rough or cut state.

In defining the gems' mass (weight) for a given jewel, it shall be specified for each article its number of gems and its total mass (weight). When necessary, it shall also be specified the individual mass (weight) for each of gems composing the jewel.



USUAL GEMS SPECIFICATIONS

The gemological materials are identified by means of their physical characteristics and properties, obtainned through tests and interpretations carried out in gemological laboratories, according to national and international technical rules.

The main section of this Handbook of Gems presents the essential characteristics of the most commonly found and commercialized gems in Brazil.

The abbreviations used in this Handbook are:

DR	Double Refraction
SR	Single Refraction
AGG	Aggregate Reaction
ADR	Anomalous Double Refraction
LW	Long-Wave Ultraviolet
SW	Short-Wave Ultraviolet

Agate

Mineral class	silicates
Mineral species	cryptocrystalline quartz
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Variety	chalcedony
Trade names	many, while some have only a local meaning; agate, moss agate, iridescent agate and fire agate
Color	various, usually bluish gray, white, brown and red; it presents "banded" structure with layers of different colors, thickness and porosity; almost all are artificially colored
Transparency	from semitransparent to opaque
Luster	from greasy to vitreous
Optical phenomena	it may present iridescence
Refractive Indices	1.535 - 1.539
Optic character	AGG
Birefringence	normally undetectable, though it may present 0,004
Dispersion	none
Pleochroism	none
Fluorescence	generally inert; some may fluoresce from weak to strong yellowish green (UVC and UVL)
Absorption spectrum	It does not present a significant spectrum; dyed green - oscillating lines around 645 and 670 nm
Specific Gravity	2,60 (+0,10, -0,05)
Fracture	conchoidal, sometimes granular with dull to waxy luster
Cleavage	none
Identifying characteristics	mineral inclusions (limonite, goethite, pyrolusite and hornblende)
Possible treatments	often dyed in various colors, due to its great porosity, mainly with metallic dyes, more stable; green (chromium salts), red (iron oxide; also with thermal treatment to Intensify the color), black (sugar and sulfuric acid), blue (potassium ferrocyanide and iron sulfate)
Possibly mistaken with	none
Hardness	6.5 - 7

STABILITY

Reaction to heat	It may change color
Stability to light	stable
Reaction to chemicals	affected by fluoridric acid; nitric acid may affect the dye

Alexandrite

Mineral class	oxides
Mineral species	chrysoberyl
Crystal system	orthorhombic
Chemical composition	$BeAl_2O_4$
Variety	alexandrite and cat's-eye alexandrite (very rare)
Trade names	alexandrite and cat's-eye alexandrite (very rare)
Color	daylight or fluorescent light: bluish green, yellowish green, brownish green or grayish green incandescent light: orangish red, brownish red or purplish red
Transparency	transparent
Luster	from vitreous to subadamantine
Optical phenomena	color change, there may also be chatoyancy
Refractive Indices	1.746 - 1.755 (+ .004, - .006)
Optic character	biaxial positive, DR
Birefringence	from .008 to .010
Dispersion	.015
Pleochroism	strong - green, orange and violacious red
Fluorescence	from inert to moderate - red (UVC and UVL)
Absorption spectrum	two strong lines at 680.5 and 678.5 nm and weak lines at 665, 655 and 645 nm, partial absorption between 580 and 630 nm, three weak lines at 476.5, 473 and 468 nm and generalized absorption of the violet region
Specific gravity	3.73 (± .02)
Fracture	conchoidal with vitreous to greasy luster
Cleavage	none
Identifying characteristics	fingerprints, silk, color change
Possible treatments	fracture filling with oil or resin
Possibly mistaken with	andalusite, color change garnet, natural and synthetic corundum, natural and synthetic spinel and synthetic alexandrite
Hardness	8.5

STABILITY

Reaction to heat	stable
Stability to light	stable
Reaction to chemicals	none

Almandine Garnet

Mineral class	silicates
Group	garnet
Mineral species	almandine
Crystal system	cubic
Chemical composition	$Fe_3Al_2(SiO_4)_3$
Variety	asteriated almandine (star almandine), usually purplish red or very dark red, with asterism
Trade names	garnet, almandine, star almandite, asteriated almandine and star garnet; misnomers:, Colorado ruby, Cape ruby, corean jade and carbuncle
Color	orangish to red, slightly purplish red to reddish purple; tipically dark In tone
Transparency	transparent to semitranslucent (for dark stones)
Luster	vitreous to subadamantine
Optical phenomena	asterism (rare), usually four-rayed, but may be six (some stones show both)
Refractive Indices	1.790 (± .030)
Optic character	SR, often ADR
Birefringence	none
Dispersion	.024
Pleochroism	none
Flourescence	inert
Absorption spectra	usually three strong bands at 504, 520 and 573 nm, but may also show fainter lines at 423, 460, 610 and 680-690 nm
Specific gravity	4.05 (+ .25, - .12)
Fracture	conchoidal, with greasy to vitreous luster
Cleavage	none; may have indistinct parting
Identifying characteristics	needle-like inclusions (usually coarse), zircon crystals with tension halos and irregular rounded crystals
Possible treatments	unknown
Possibly mistaken with	pyrope, rhodolite, natural and synthetic ruby, natural and synthetic red spinel, spessartine, hessonite, malaya garnet and garnet / glass doublet
Hardness	7 - 7.5

STABILITY

Reaction to heat	abrupt temperature changes may cause fracturing
Stability to light	stable
Reaction to chemicals	very slightly attacked by concentrated hydrofluoric acid

Amethyst

Mineral class	silicates
Mineral species	quartz
Crystal system	hexagonal (trigonal).
Chemical composition	SiO_2
Variety	ametrine, bicolor variety of amethyst with citrine, also known as citrine-amethyst
Trade names	bishop stone, siberian amethyst, amethyst, ametrine and citrine-amethyst
Color	from bluish purple to pure purple to reddish purple
Transparency	transparent (the material used for sculpture may be translucent)
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.544 - 1.553
Optic character	uniaxial positive, DR
Birefringence	.009
Dispersion	.013
Pleochroism	from weak to moderate - purple and reddish purple or bluish purple
Fluorescence	usually inert, it may present weak blue fluorescence under UVC light
Absorption spectrum	not diagnostic
Specific gravity	2.66 (+.03, - .02)
Fracture	conchoidal with vitreous luster
Cleavage	none
Identifying characteristics	color zoning, twinning, liquid inclusions, two-phase inclusions, three-phase Inclusions, negative crystals and fractures
Possible treatments	thermal treatments (to enlighten a very dark amethyst; to produce citrine and green quartz; to remove smoking stains of color) - coating or foil at the cabochon's bottom (improves the color)
Possibly mistaken with	iolite, scapolite, synthetic amethyst, tanzanite, synthetic corundum, fluorite and kunzite
Hardness	7

STABILITY

Reaction to heat	high temperatures make the gem colorless, it may produce citrine or prasiolite, though a weak temperature may clear it up; an abrupt change of temperature may fracture it
Stability to light	it may lose its color
Reaction to chemicals	soluble in fluoridric acid and ammonium fluoride; weakly soluble in alcalis

Andalusite

Mineral class	silicates
Mineral species	andalusite
Crystal system	orthorhombic; prismatic habit with nearly square transversal sections
Chemical composition	Al_2SiO_5
Variety	chiastolite, viridine (green variety, in which traces of manganese replace part of the aluminum)
Trade names	andalusite, chiastolite and cross-stone
Color	usually from brownish green or yellowish green to orangish brown (often the pleochroic colors green and orange are seen by the crown); it may only be green, brown, pink, violet (rare); chiastolite presents a dark cross in contrast with a white, grey, red or light brown bottom.
Transparency	from transparent to opaque
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.634 - 1.643 (± .005)
Optic character	biaxial negative, DR; chiastolite, AGG
Birefringence	from .007 to .013
Dispersion	.016
Pleochroism	strong - from brownish green to yellowish green and from brownish orange to brownish red
Fluorescence	inert (UVL); from inert to moderate, green to yellowish green (UVC)
Absorption spectrum	greenish brown samples present a band at 455nm (blue) and exhibit intense absorption in the violet region; green samples show intense lines at 553nm and 550nm (green region), in addition to total absorption in the violet region; the spectrum is due to manganese
Specific gravity	3.17 (± .04); chiastolite may be consistently lighter
Fracture	from uneven to conchoidal with vitreous luster
Cleavage	distinct in one direction
Identifying characteristics	yellowish green material becomes pinkish by thermal treatment, while brown samples turn to colorless at approximately 8000C; irradiation probably reverts these changes
Possible treatments	mineral inclusions (biotite, apatite, quartz), acicular inclusions of rutile irregularly disposed and two-phase inclusions, strong pleochroism. chiastolite contains inclusions of graphite with cross-like outlines
Possibly mistaken with	tourmaline, topaz, apatite, danburite, barite and chrysoberyl
Hardness	7 - 7.5

STABILITY

Reaction to heat	stable unless it presents liquid inclusions
Stability to light	stable
Reaction to chemicals	none

Andradite Garnet

Mineral class	silicates
Group	garnet
Mineral species	andradite
Crystal system	cubic
Chemical composition	$Ca_3Fe_2(SiO_4)_3$
Variety	demantoid, topazolite and melanite
Trade names	andradite, demantoid, topazolite and melanite; misnomers: olivine
Color	yellow, green, brown and black
Transparency	transparent to opaque
Luster	vitreous to subadamantine
Optical phenomena	chatoyancy (sometimes in topazolite variety) and iridescence (sometimes in dark semitranslucent to opaque specimens; resembles black opal)
Refractive Indices	1,888 (+ .007, - .003)
Optic character	SR, often ADR
Birefringence	none
Dispersion	.057
Pleochroism	none
Flourescence	inert
Absorption spectra	demantoid - dark band nearly at 440 nm; may also exhibit lines at 618, 634, 685 and 690 nm
Specific gravity	3.84 (± .03); melanite - 3.90 (± .20)
Fracture	conchoidal to uneven, with vitreous luster
Cleavage	none, may show indistinct parting
Identifying characteristics	demantoid - yellowish brown, curving, radiating needle-like "horse-tail" inclusions (not seen in any other green stone), noticealbe dispersion, especially in lighter samples; translucent to opaque yellow, brown to black stones - twinning in rhombic mosaic patterns commom, giving play-of-color-like iridescence
Possible treatments	unknown
Possibly mistaken with	diamond, sphalerite, zircon, colored cubic zirconia, colored YAG, sphene and grossular
Hardness	6.5 - 7
STABILITY	
Reaction to heat	abrupt temperature changes likely to cause fracturing
Stability to light	stable
Reaction to chemicals	slightly attacked by hydrofluoric acid

Apatite

Mineral class	phosphates
Mineral species	apatite
Crystal system	hexagonal; prismatic or tabular habit
Chemical composition	$Ca_5(PO_4)_3(F,OH,Cl)$
Variety	cat's-eye apatite
Trade names	cat's-eye apatite, asparagus-stone and apatite
Color	blue, green, yellow, purple, colorless, pink, brown and violet
Transparency	from transparent to translucent
Luster	vitreous
Optical phenomena	chatoyancy
Refractive Indices	1.634 - 1.638 (+ .012, - .006)
Optic character	uniaxial negative, DR
Birefringence	from .002 to .008
Dispersion	.013
Pleochroism	blue samples - strong, blue and yellow to colorless other colors - from very weak to weak
Fluorescence	• yellow samples - purplish pink (stronger under UVL) • blue samples - from blue to light blue (UVL and UVC) • green samples - greenish yellow (stronger under UVL) • violet samples - greenish yellow (UVL), light purple (UVC)
Absorption spectrum	colorless, yellow and chatoyant samples - it is common to exhibit a double line at approximately 580 nm
Specific gravity	3.18 (± .05)
Fracture	from conchoidal to uneven with vitreous luster
Cleavage	imperfect, in two directions
Identifying characteristics	fluid inclusions, growth tubes, healing planes, it may present pseudobiaxial optic figure
Possible treatments	no commercial treatment
Possibly mistaken with	tourmaline, topaz, andalusite, danburite, barite and cat's-eye actinolite
Hardness	5

STABILITY

Reaction to heat	very sensitive, it may lose its color
Stability to light	usually stable, pink samples may lose their color
Reaction to chemicals	affected by chloridric and sulfuric acids

Aquamarine

Mineral class	silicates
Mineral species	beryl
Crystal system	hexagonal; elongated prismatic habit
Chemical composition	$Be_3Al_2Si_6O_{18}$
Variety	aquamarine, cat's-eye aquamarine
Trade names	• Madagascar's aquamarine - medium blue • Brazil's aquamarine - bluish green and greenish blue
Color	from greenish blue to green-blue, generally in light tones
Transparency	from transparent to translucent
Luster	vitreous
Optical phenomena	chatoyancy, rare and generally weak
Refractive Indices	1.577 - 1.583 (±0,017)
Optic character	uniaxial negative, DR
Birefringence	from .005 to .009
Dispersion	.014
Pleochroism	from weak to moderate - blue and greenish blue, or different blue tones
Fluorescence	inert
Absorption spectrum	indistinct lines at 537 nm and 456 nm, and a strong line at 427 nm depending on the color saturation
Specific gravity	2.72 (+.18, - .05)
Fracture	conchoidal with vitreous to resinous luster
Cleavage	very weak in one direction, almost never seen; basal
Identifying characteristics	relatively free of inclusions; hollow growth tubes or tubes filled with fluids, parallel to the c-axis ("rain effect"); radially-arranged fluid drops ("snow star" or "chrysantemum") and, less frequently, mineral inclusions (iron oxide)
Possible treatments	greenish blue samples turn to blue (removing the yellow component or color center) by thermal treatment at temperatures between 400 and 450°C, approximately (stable, irreversible)
Possibly mistaken with	blue topaz, synthetic blue spinel, synthetic blue quartz and Maxixe beryl (a kind of beryl treated by irradiation)
Hardness	7.5 - 8

STABILITY

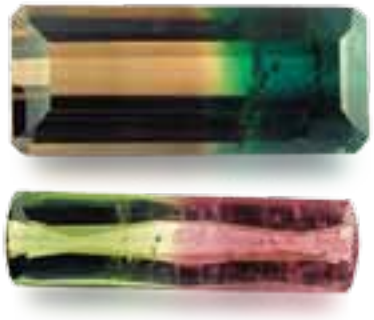
Reaction to heat	it is not generally sensitive unless it contains liquid inclusions
Stability to light	stable
Reaction to chemicals	affected by fluoridric acid

Aventurine Quartz

Mineral class	silicates
Mineral species	quartz
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Variety	aventurine quartz
Trade names	aventurine quartz; misnomers: indian jade
Color	green, gray and yellow to brown
Transparency	translucent to opaque
Luster	vitreous
Optical phenomena	aventurescence
Refractive Indices	1.544 - 1.553
Optic character	uniaxial positive, DR; AGG
Birefringence	.009, usually undetectable
Dispersion	.013
Pleochroism	weak to moderate
Flourescence	inert to weak - grayish green or reddish (LW e SW)
Absorption spectra	bands at approximately 682 and 649 nm (probably due to mica inclusions)
Specific gravity	2.66 (+ .03, - .02)
Fracture	conchoidal to irregular or granular, with vitreous luster
Cleavage	none
Identifying characteristics	lamellae or platelet inclusions (hematite, pyrite; fuchsite and other micas) that cause the aventurescence
Possible treatments	unknown
Possibly mistaken with	aventurine feldspar, jade, aventurine glass, amazonite, emerald, dyed green quartz and chalcedony
Hardness	7

STABILITY

Reaction to heat	may fracture when subjected to abrupt temperature changes; strong heat may alter or destroy color
Stability to light	stable
Reaction to chemicals	soluble in hydrofluoric acid and ammonium fluoride; very slightly soluble in alkalies



Bicolor Tourmaline

Mineral class	silicates
Group	tourmaline
Mineral species	elbaite
Crystal system	hexagonal (trigonal)
Chemical composition	$(Ca,K,Na)(Al,Fe,Li,Mg,Mn)_3(Al,Cr,Fe,V)_6(BO_3)_3Si_6O_{18}(OH,F)_4$
Variety	bicolor toumaline and polychromic tourmaline
Trade names	bicolor toumaline and polychromic tourmaline
Color	more than one distinct color
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	chatoyancy
Refractive Indices	1.624 - 1.644 (+ .011, - .009)
Optic character	uniaxial negative, DR
Birefringence	.018 a .040
Dispersion	.017
Pleochroism	none
Flourescence	inert
Absorption spectra	variable
Specific gravity	3.06 (+.20 - .06)
Fracture	conchoidal, with vitreous luster
Cleavage	none
Identifying characteristics	gaseous and liquid inclusions
Possible treatments	irradiation - pale colors to pink or red; blue or dark green to purple; yellow to orange (peach); pale colors to yellow; green-blue to green-yellow; pink to orangish; thermal treatment - red to lighter red to colorless; brownish red to pink; purple to blue or dark green; dark blue and green to lighter blue and green or green-yellow
Possibly mistaken with	apatite and fluorite
Hardness	7 - 7.5

STABILITY

Reaction to heat	strong heat may alter color; sudden temperature change (heating or cooling) may cause fracturing
Stability to light	stable
Reaction to chemicals	none

Bloodstone

Mineral class	silicates
Mineral species	cryptocrystalline quartz
Variety	chalcedony
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Trade names	bloodstone, heliotrope and blood jasper
Color	dark green, with red to brownish red spots
Transparency	semitranslucent to opaque
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.535 - 1.539
Optic character	AGG
Birefringence	usually undetectable, but may show .004
Dispersion	none
Pleochroism	none
Flourescence	generally inert
Absorption spectra	not diagnostic
Specific gravity	2.60 (+ .10 - .05)
Fracture	conchoidal, sometimes granular, with dull to waxy luster
Cleavage	none
Identifying characteristics	iron oxide inclusions, which origins brownish red spots
Possible treatments	none
Possibly mistaken with	unique appearance
Hardness	6.5 - 7

STABILITY

Reaction to heat	color may change
Stability to light	stable
Reaction to chemicals	attacked by hydrofluoric acid

Brazilianite

Mineral class	phosphates
Mineral species	brazilianite
Crystal system	monoclinic; prismatic or pinachoidal habit
Chemical composition	$NaAl_3(PO_4)_2(OH)_4$
Trade names	brazilianite and by color
Color	from yellowish green to greenish yellow, rarely colorless
Transparency	from transparent to translucent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.602 - 1.621 (± .003)
Optic character	biaxial positive, DR
Birefringence	from .019 to .021
Dispersion	.014
Pleochroism	very weak dichroism
Fluorescence	inert
Absorption spectrum	not diagnostic
Specific gravity	2,97 (±0,03)
Fracture	conchoidal with vitreous luster
Cleavage	perfect in one direction
Identifying characteristics	phase inclusions, healing plans and mineral inclusions (tourmaline, apatite and muscovite)
Possible treatments	unknown
Possibly mistaken with	ambligonite, tourmaline, ekanite and topaz
Hardness	5.5

STABILITY

Reaction to heat	sensitive, it may lose color
Stability to light	stable
Reaction to chemicals	slowly affected by acids

Calcite

Mineral class	carbonates
Group	calcite
Mineral species	calcite
Crystal system	hexagonal (trigonal)
Chemical composition	$CaCO_3$
Variety	Iceland spar, marble and onyx marble
Trade names	Iceland spar, marble and onyx marble; erroneous: mexican jade, eastern alabaster, mexican onyx and californian onyx
Color	almost all colors
Transparency	from transparent to opaque
Luster	from vitreous to greasy
Optical phenomena	chatoyancy
Refractive Indices	1.486 - 1.658
Optic character	uniaxial negative, DR; AGG
Birefringence	.172
Dispersion	.017
Pleochroism	from inert to weak
Fluorescence	variable
Absorption spectrum	any observed line is caused by impurities or dye
Specific gravity	2.70 (± .05)
Fracture	from granular to uneven to fibrous, with dull (in aggregates) to subvitreous luster
Cleavage	perfect in three directions; many times obscure in aggregates
Identifying characteristics	high birefringence in aggregates; strong doubling in transparent varieties
Possible treatments	dyeing, plastic or paraffin impregnation and irradiation
Possibly mistaken with	aragonite, chalcedony, coral and alabaster
Hardness	3

STABILITY

Reaction to heat	melts under high temperature
Stability to light	natural colors are stable
Reaction to chemicals	effervescence in contact with some acids

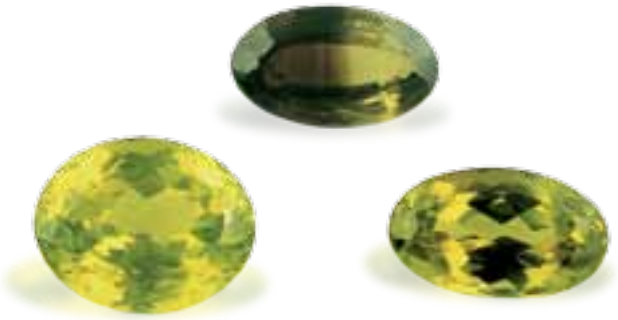
Cat´s-Eye

Mineral class	oxides
Mineral species	chrysoberyl
Crystal system	orthorhombic
Chemical composition	$BeAl_2O_4$
Variety	cat's-eye and cat's-eye alexandrite
Trade names	cat's-eye and cat's-eye alexandrite
Color	yellow to yellowish green, grayish green and brown to brownish yellow
Transparency	semitransparent to semitranslucent
Luster	vitreous to subadamantine
Optical phenomena	chatoyancy; may also show color change; extremely rare cases of 4-ray asterism instead of chatoyancy
Refractive Indices	1.746 - 1.755 (+.004, - .006)
Optic character	DR, biaxial positive
Birefringence	.008 to .010
Dispersion	none
Pleochroism	similar to non-chatoyant varieties of equal color; Intensity affected by transparency (see chrysoberyl and alexandrite)
Flourescence	inert; cat's-eye alexandrite - inert to moderate red (SW e LW)
Absorption spectra	similar to transparent varieties of equal color (see chrysoberyl and alexandrite)
Specific gravity	3.73 (± .02)
Fracture	conchoidal, with vitreous to greasy luster
Cleavage	none
Identifying characteristics	"silk-like" inclusions
Possible treatments	unknown
Possibly mistaken with	quartz, synthetic cat's-eye alexandrite and other cat's-eye materials
Hardness	8.5

STABILITY

Reaction to heat	stable
Stability to light	stable
Reaction to chemicals	none

Chrysoberyl



Mineral class	oxides
Mineral species	chrysoberyl
Crystal system	orthorhombic
Chemical composition	$BeAl_2O_4$
Variety	cat's-eye chrysoberyl, alexandrite and cat's-eye alexandrite
Trade names	chrysoberyl, cat's-eye chrysoberyl, alexandrite and cat's-eye alexandrite
Color	from light to medium yellow, to yellowish green, grayish green, from brown to yellowish brown and light blue (rare)
Transparency	from transparent to opaque
Luster	from vitreous to subadamantine
Optical phenomena	color change and chatoyancy
Refractive Indices	1.746 - 1.755 (+ .004, - .006)
Optic character	biaxial positive, DR
Birefringence	.008 to .010
Dispersion	.015
Pleochroism	transparent yellow, green or brown samples - from weak to moderate, normally different tones of gem color
Fluorescence	yellow and greenish yellow samples - from inert to weak, yellowish green (UVC); other colors are generally inert
Absorption	from yellow to yellowish green - strong band at 445 nm
Specific gravity	3.73 (± .02)
Fracture	conchoidal with vitreous to greasy luster
Cleavage	indistinct, in three directions, rarely observed
Identifying characteristics	fingerprints, silk; transparent gems may present straight and angular planes and step-like features
Possible treatments	unknown
Possibly mistaken with	natural and synthetic corundum, grossular, natural and synthetic spinel
Hardness	8.5

STABILITY

Reaction to heat	stable
Stability to light	stable
Reaction to chemicals	none

Chrysoprase

Mineral class	silicates
Mineral species	cryptocrystalline quartz
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Variety	chalcedony
Trade names	chrysoprase
Color	from light to medium yellowish green
Transparency	from semitransparent to translucent
Luster	from greasy to vitreous
Optical phenomena	none
Refractive Indices	1.535 - 1.539
Optic character	AGG
Birefringence	normally undetectable, though it may present 0,004
Dispersion	none
Pleochroism	none
Fluorescence	inert
Absorption spectrum	not diagnostic
Specific gravity	2.60 (+ .10, - .05)
Fracture	conchoidal, sometimes granular, with dull to waxy luster
Cleavage	none
Identifying characteristics	hydrated nickel silicate which acts as a colorant agent
Possible treatments	dyeing with nickel nitrate for color intensification
Possibly mistaken with	jade, prase, prehnite, bowenite and dyed green chalcedony
Hardness	6.5 - 7

STABILITY

Reaction to heat	It may change the color
Stability to light	stable
Reaction to chemicals	affected by fluoridric acid; nitric acid may affect the dye

Citrine

Mineral class	silicates
Mineral species	quartz
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Variety	citrine
Trade names	citrine; erroneous: Spain topaz, Madeira topaz, citrine topaz, topaz quartz, Bahia topaz, Rio Grande topaz, gold topaz, palm topaz and topaz citrine
Color	from yellow to orange to brownish orange
Transparency	transparent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.544 - 1.553
Optic character	uniaxial positive, DR
Birefringence	.009
Dispersion	.013
Pleochroism	very weak, different tones of yellow or orange
Fluorescence	inert
Absorption spectrum	not diagnostic
Specific gravity	2,66 (+0,03, - 0,02)
Fracture	conchoidal with vitreous luster
Cleavage	none
Identifying characteristics	color zoning, two-phase and three-phase inclusions, fractures, negative crystals and liquid inclusions
Possible treatments	thermal (transforms amethyst in citrine) - (transforms the "honey-color quartz" from smoky quartz) - coating at the bottom of the cabochon (improves the color)
Possibly mistaken with	beryl, orthoclase, scapolite, synthetic citrine, topaz, amber, tourmaline and labradorite
Hardness	7

STABILITY

Reaction to heat	it may fracture when submitted to an abrupt change of temperature; elevated temperature turns the stone to colorless
Stability to light	stable
Reaction to chemicals	soluble in fluoridric acid and ammonium fluoride; weakly soluble in alcalis

Cornelian

Mineral class	silicates
Mineral species	cryptocrystalline quartz
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Variety	chalcedony
Trade names	cornelian and carnelian
Color	from orange-yellow to orangish red, brownish red or brownish orange
Transparency	from semitransparent to translucent
Luster	From vitreous to greasy
Optical phenomena	none
Refractive Indices	1.535 - 1.539
Optic character	AGG
Birefringence	normally undetectable, though it may present .004
Dispersion	none
Pleochroism	none
Fluorescence	generally inert
Absorption spectrum	not diagnostic
Specific gravity	2.60 (+.10, - +05)
Fracture	conchoidal, sometimes granular, with dull to waxy luster
Cleavage	none
Identifying characteristics	hematite, which plays the role of a colorant agent
Possible treatments	orange to brown material acquires red hue by thermal treatment
Possibly mistaken with	fire opal, amber, glass and fluorite
Hardness	6.5 - 7

STABILITY

Reaction to heat	It may change the color
Stability to light	stable
Reaction to chemicals	affected by fluoridric acid; nitric acid may affect the dye

Dendrite Quartz

Mineral class	silicates
Mineral species	cryptocrystalline quartz
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Variety	chalcedony
Trade names	dendrite quartz, dendrite agate, landscape agate and "mosquito" stone
Color	brownish colorless, grayish or whitish with inclusions (iron and manganese oxides) of various colors (yellow to brown until black), arborescent form
Transparency	transparent to translucent
Luster	greasy to vitreous
Optical phenomena	none
Refractive Indices	1.535 - 1.539
Optic character	AGG
Birefringence	usually undetectable
Dispersion	none
Pleochroism	none
Flourescence	variable
Absorption spectra	not diagnostic
Specific gravity	2.60 (+ .10 - .05)
Fracture	conchoidal, sometimes granular, with dull to waxy luster
Cleavage	none
Identifying characteristics	iron and manganese inclusions, liquids, negative crystals, two-phase and three-phase inclusions and fractures
Possible treatments	none
Possibly mistaken with	none
Hardness	6.5 - 7

STABILITY

Reaction to heat	may fracture when subjected to abrupt temperature changes, may lose or change color under high temperature
Stability to light	stable
Reaction to chemicals	attacked by hydrofluoric acid

Diamond

Mineral class	native elements
Crystal system	cubic
Chemical composition	C
Variety	diamond
Trade names	diamond, brilliant, canary, champagne, cognac, river, premier, jager, chameleon, cape diamond, savoian diamond, piqué and "fancy" diamond
Color	usually from very light yellow, gray and brown to colorless (very rare); "fancy" colors: yellow, gray and brown darker than 'Z' grade; blue, green, orange, pink, red and purple in very light to dark tones and black
Transparency	from transparent to opaque
Luster	adamantine
Optical phenomena	none
Refractive Indices	2.417
Optic character	RS
Birefringence	none
Dispersion	.044
Pleochroism	none
Fluorescence	colourless to yellow samples - from inert to strong, usually blue (LW and weaker under SW)
Absorption spectra	line at 415.5 nm from the Cape series, when cooled to low temperature, irradiated and annealed stones often exhibit a thin line at approximately 594 nm
Specific gravity	3.52 (±.01)
Fracture	step-like or splintery with adamantine luster
Cleavage	perfect in four directions; octahedral
Identifying characteristics	naturals, granular to waxy girdle surface, bearding, sharp facet junctions, angular inclusions, no see-through effect, thermal conductivity higher than those from simulants and adamantine luster
Possible treatments	irradiation many times followed by controlled thermal treatment, laser drilling followed by whitening, fracture filling with resin, plastic coating and high pressure/high temperature (HPHT)
Possibly mistaken with	cubic zirconia, YAG, GGG, synthetic rutile, zircon, synthetic spinel, strontium titanate, synthetic sapphire, synthetic diamond, demantoid and synthetic moissanite
Hardness	10

STABILITY

Reaction to heat	vaporization begins at 690°C - 875°C range in an oxygen-rich atmosphere
Stability to light	stable
Reaction to chemicals	none

Conglomerate from Diamantina Region | Minas Gerais State | Brazil

African *blue ground* kimberlite plate

Yellow ground kimberlite from Rondônia State | Brazil

Altered kimberlite from Juína Region | Mato Grosso | Brazil

Blue ground kimberlite from Minas Gerais State | Brazil

Collection of rough diamonds from brazilian sources in various colors and habits

Diopside

Mineral class	silicates
Group	pyroxene
Mineral species	diopside
Crystal system	monoclinic
Chemical composition	$CaMgSi_2O_6$
Variety	cat's-eye diopside, star diopside, malacolite, violane, alalite and e chrome diopside.
Trade names	diopside, cat's-eye diopside, star diopside, malacolite, violane, alalite and chrome diopside.
Color	star diopside - dark green to black with asterism; cat's-eye diopside - dark green; malacolite - trasnlucent light colored stones; alatite - colorless to faint greenish or light yellowish green; violane - rare, massive translucent to opaque dark violet-blue; chrome diopside - transparent medium to dark vivid green
Transparency	from transparent to opaque
Luster	vitreous to resinous
Optical phenomena	asterism (usually 4-rayed, may be 6), chatoyancy
Refractive Indices	1.675 – 1.701 (+ .029 - .010), spot reading usually around 1.68
Optic character	DR, biaxial positive; AGG
Birefringence	.024 to .030
Pleochroism	weak to strong, light to dark green
Flourescence	green samples - green (LW), inert (SW)
Absorption spectra	505 nm line commom; chromium – 635, 655, 670 nm, doublet at 690 nm
Specific gravity	3.29 (+ .11, - .07)
Fracture	conchoidal to uneven with vitreous to resinous luster
Cleavage	perfect in two directions
Identifying characteristics	asterism - usually with 4 rays
Possible treatments	unknown
Possibly mistaken with	peridot, dioptase, enstatite, zoisite and kornerupine
Hardness	5.5 – 6

STABILITY

Reaction to heat	fuses under jeweler's torch
Stability to light	stable
Reaction to chemicals	attacked by hydrofluoric acid

Emerald

Mineral class	silicates
Mineral species	beryl
Crystal system	hexagonal
Chemical composition	$Be_3Al_2Si_6O_{18}$
Variety	trapiche emerald, star emerald, cat's-eye emerald and emerald
Trade names	• colombian emerald - applied as a trade grade to fine quality emeralds • russian or siberian - less bluish, more included and lighter in tone than fine colombian stones • brazilian emerald - sometimes applied to light green stones; occasionally applied to stones more properly called green beryl • Sandawana emerald - deep color, but usually small and highly included • zambian emerald - tends to have a slight grayish hue
Color	light to very dark green to very Intense bluish green
Transparency	from transparent to translucent
Luster	vitreous
Optical phenomena	chatoyancy and asterism (rare)
Refractive Indices	1.577 - 1.583 (±.017)
Optic character	uniaxial negative, DR
Birefringence	.005 to .009
Dispersion	.014
Pleochroism	moderate to strong, bluish green and yellowish green
Flourescence	usually inert but may fluoresce orangy red to red in very fine colors (LW and SW; LW stronger); oiled emerald - oil in fractures may fluoresce yellowish green to greenish yellow (LW), from weak to inert (SW)
Absorption spectra	distinct lines at 663 and 680.5 nm, less distinct lines at 662 and 646 nm, partial absorption between 630 and 580 nm and almost complete absorption of the violet
Specific gravity	2.72 (+ .18, - .05)
Fracture	conchoidal with a vitreous to resinous luster
Cleavage	very difficult in one direction, basal, almost never seen

Identifying characteristics	two-phase inclusions, three-phase inclusions (mainly in colombian stones), negative crystals, liquid "feathers"; calcite, pyrite, mica, hornblende, actinolite, chromite, dolomite and pyrrhotite inclusions; tremolite needles
Possible treatments	• cracks or surface cavities fillings - with a hardener substance (good stability) • impregnation - with oil, wax, resin or colorless plastic, not hardened, in cracks or cavities to improve appearance (good to medium stability) • dyeing - with dye or colored oil (detection: dye concentrates in fissures)
Possibly mistaken with	synthetic emerald, chrome diopside, Paraíba tourmaline, tsavorite, demantoid, uvarovite, composite gems, glass, plastic coated beryl and dioptase
Hardness	7.5 - 8

STABILITY

Reaction to heat	may cause additional fracturing or complete breakage
Stability to light	stable, except possible fading in stones treated with green oil
Reaction to chemicals	resistant to all acids except for hydrofluoric; solvents may remove oil

Epidote

Mineral class	silicates
Group	epidote
Mineral species	epidote
Crystal system	monoclinic
Chemical composition	$Ca_2(Al,Fe)_3(SiO_4)_3(OH)$
Variety	pistacite
Trade names	pistacite and epidote
Color	light to very dark green, brown, yellow and black
Transparency	transparent to translucent
Luster	vitreous to greasy
Optical phenomena	none
Refractive Indices	1.729 - 1.768 (+.012, - .035)
Optic character	RD, biaxial negative, may show pseudo-uniaxial optic figure
Birefringence	.019 to .045
Dispersion	.030
Pleochroism	green samples - intense green and green brown samples - brown and yellow
Flourescence	generally inert
Absorption spectra	Very strong band at 455 nm and sometimes weak line at 475 nm
Specific gravity	3.40 (+.10 - .15)
Fracture	uneven to conchoidal with vitreous to greasy luster
Cleavage	perfect in one direction
Identifying characteristics	none
Possible treatments	unknown
Possibly mistaken with	kyanite, idocrase, zoisite and tourmaline
Hardness	6 - 7

STABILITY

Reaction to heat	fusible
Stability to light	stable
Reaction to chemicals	partly decomposed by hot and concentrated hydrochloric acid, more rapidly by hydrofluoric acid

Euclase

Mineral class	silicates
Mineral species	euclase
Crystal system	monoclinic
Chemical composition	$BeAlSiO_4OH$
Trade names	euclase
Color	colorless, yellowish green to bluish green, blue to greenish blue, usually light In tone
Transparency	transparent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.652 - 1.671 (+ .006, - .002)
Optic character	biaxial positive, DR
Birefringence	.019 to .020
Dispersion	.016
Pleochroism	• blue samples - weak, bluish gray and light blue • green samples - grayish green and green
Flourescence	inert to weak
Absorption spectra	two diffuse bands at 468 and 455 nm (also, occasionally, chromium lines around 690 nm)
Specific gravity	3,08 (+ .04, - .08)
Fracture	conchoidal with a vitreous luster
Cleavage	perfect in one direction
Identifying characteristics	may present color zoning, often light in tone; red or blue plate-like inclusions are commom
Possible treatments	irradiation
Possibly mistaken with	aquamarine, beryl, spodumene (hiddenite), phenakite and sillimanite
Hardness	7.5

STABILITY

Reaction to heat	fuses under jeweler's torch
Stability to light	stable
Reaction to chemicals	attacked slowly by hydrofluoric acid

Fluorite

Mineral class	halides
Mineral species	fluorite
Crystal system	cubic
Chemical composition	CaF_2
Trade names	fluorspar, Blue John and fluorite
Color	colorless, yellow, orange, pink, blue, green, brown, purple and violet
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	color change
Refractive Indices	1.434 (± .001)
Optic character	RS; AGG
Birefringence	none
Dispersion	.007
Pleochroism	none
Flourescence	variable, but often strong
Absorption spectra	two diffuse bands at 468 and 455 nm (also, occasionally, chromium lines around 690 nm); lines at 427, 445, 610 and 630 nm; bands at 570 to 590 nm; parcial absorption at 670 to 710 nm
Specific gravity	3.18 (+ .07, - .18)
Fracture	conchoidal, step-like or splintery, with vitreous to subvitreous luster
Cleavage	perfect in four directions
Identifying characteristics	color zoning, two-phase inclusions, three-phase inclusions, hematite inclusions, negative crystals and cleavage
Possible treatments	plastic or epoxy resin impregnation (seals fractured surfaces as to so produce delicate carvings without breaking); irradiation (poduces violet color from colorless); thermal treatment (lightens dark blue to black samples)
Possibly mistaken with	opal, quartz, chalcedony and beryl
Hardness	4

STABILITY

Reaction to heat	very sensitive
Stability to light	stable
Reaction to chemicals	decomposed by sulfuric acid

Green Beryl

Mineral class	silicates
Mineral species	beryl
Crystal system	hexagonal
Chemical composition	$Be_3Al_2Si_6O_{18}$
Variety	green beryl
Trade names	green beryl
Color	very light green, with low or no saturation, or yellowish green, without sufficient saturation to be denominated emerald
Transparency	from transparent to opaque
Luster	vitreous
Optical phenomena	chatoyancy and asterism (rare)
Refractive Indices	1.577 - 1.583 (± .017)
Optic character	uniaxial negative, DR
Birefringence	.005 to .009
Dispersion	.014
Pleochroism	weak to moderate dichroism, bluish green and green or different green tones
Fluorescence	generally inert
Absorption spectrum	not diagnostic
Specific gravity	2.72 (+.18, - .05)
Fracture	conchoidal with vitreous to resinous luster
Cleavage	very weak in one direction, basal, almost never seen
Identifying characteristics	liquid, two-phase or tubular inclusions
Possible treatments	the same applied for emerald, in addition to resin or coloured plastic coatings
Possibly mistaken with	emerald, synthetic emerald, chrome-diopside, chrome tourmaline, Paraíba tourmaline, grossular (tsavorite), demantoid, uvarovite, composite gems, glass and dioptase
Hardness	7.5 - 8

STABILITY

Reaction to heat	heating makes the oil to transpire from the fissures of treated stones; one must be careful on heating it due to its fragility
Stability to light	stable
Reaction to chemicals	resistant to all acids, with the exception of fluoridric acid, solvents may dissolve its resin or plastic coating

Green Quartz

Mineral class	silicates
Mineral species	quartz
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Variety	prasiolite (green color is usually produced by heat treatment of some amethysts and morions)
Trade names	greenish amethyst, green quartz and prasiolite
Color	green to yellowish green
Transparency	transparent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.544 - 1.553
Optic character	uniaxial positive, DR
Birefringence	.009 (may not be detectable in aggregate varieties)
Dispersion	.013
Pleochroism	very weak - light green, pale green
Flourescence	generally inert
Absorption spectra	not diagnostic
Specific gravity	2.66 (+ .03, - .02)
Fracture	conchoidal to irregular or granular (in aggregates), with vitreous luster
Cleavage	none
Identifying characteristics	liquid inclusions, two-phase and three-phase Inclusions, color zoning, twinning plans and negative crystals
Possible treatments	can be produced by heat treatment, with temperatures between 100 and 500ºC, from some amethysts, morions and yellow quartzs, together with irradiation. may modify or lose the green color if submitted to high temperatures
Possibly mistaken with	apatite, beryl, fluorite, hiddenite, peridot and tourmaline
Hardness	7

STABILITY

Reaction to heat	may fracture when subjected to abrupt temperature changes; may lose or change color under high temperature
Stability to light	stable
Reaction to chemicals	soluble in hydrofluoric acid and ammonia fluoride; very slightly soluble in alkalies

Green Tourmaline

Mineral class	silicates
Group	tourmaline
Mineral species	elbaite
Crystal system	trigonal
Chemical composition	$(Ca,K,Na)(Al,Fe,Li,Mg,Mn)_3(Al,Cr,Fe,V)_6(BO_3)_3Si_6O_{18}(OH,F)_4$
Variety	green tourmaline, cat's-eye tourmaline and color change tourmaline
Trade names	green tourmaline, cat's-eye tourmaline and color change tourmaline
Color	green, yellowish green to bluish green
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	chatoyancy and color change (rare)
Refractive Indices	1.624 - 1.644 (+ .011, - .009)
Optic character	uniaxial negative, DR
Birefringence	.018 to .040, usually .020; may be .040 in dark samples
Dispersion	.017
Pleochroism	moderate to strong - generally different tones
Flourescence	none
Absorption spectra	almost complete absorption of the red down to 640 nm, in addition to a strong narrow band at 498 nm
Specific gravity	3.06 (+ .20 - .06)
Fracture	conchoidal, with vitreous luster
Cleavage	none
Identifying characteristics	liquid and gaseous inclusions in lines
Possible treatments	heating - produces emerald-green tone; irradiation - dark green can turn to purple
Possibly mistaken with	peridot, emerald, prasiolite, synthetic green spinel, vesuvianite, glass imitation, demantoid, hiddenite and synthetic green quartz
Hardness	7 - 7.5

STABILITY

Reaction to heat	strong heat may alter color; sudden temperature change (heating or cooling) may cause fracturing
Stability to light	stable
Reaction to chemicals	none

Grossular Garnet

Mineral class	silicates
Group	garnet
Mineral species	grossular
Crystal system	cubic
Chemical composition	$Ca_3Al_2(SiO_4)_3$
Variety	hessonite, tsavorite, rosolite, xalostocite and landerite
Trade names	hessonite, tsavorite, leucogarnet, rosolite, cinnamon stone, jacinth, grossular, landerite and xalostocite
Color	colorless (rare), light to dark yellow to reddish orange, light to dark green
Transparency	transparent to semitransparent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.740 (+ .02. - .010)
Optic character	SR, often shows ADR
Birefringence	none
Dispersion	.028
Pleochroism	none
Flourescence	near colorless to light green samples - inert to weak orange (LW) and weak yellow-orange (SW) yellow samples - inert to weak orange (LW and SW)
Absorption spectra	hessonite may show bands at 407 and 430 nm
Specific gravity	3.61 (+ .12, - .04)
Fracture	conchoidal to uneven, with greasy to vitreous luster
Cleavage	none
Identifying characteristics	hessonite - stubby, rounded included crystals and a "heat-wave" effect
Possible treatments	unknown
Possibly mistaken with	almandine, pyrope, natural and synthetic corundum, natural and synthetic spinel, spessartine, chrysoberyl and andradite
Hardness	7 - 7.5

STABILITY

Reaction to heat	abrupt temperature changes likely to cause fracturing
Stability to light	stable
Reaction to chemicals	slightly attacked by hydrofluoric acid

Heliodor

Mineral class	silicates
Mineral species	beryl
Crystal system	hexagonal
Chemical composition	$Be_3Al_2Si_6O_{18}$
Variety	heliodor
Trade names	heliodor, yellow beryl and golden beryl
Color	greenish yellow through orangish yellow or yellowish brown
Transparency	from transparent to opaque
Luster	vitreous
Optical phenomena	chatoyancy and asterism (rare)
Refractive Indices	1.577 - 1.583 (± .017)
Optic character	uniaxial negative, DR
Birefringence	.005 to .009
Dispersion	.014
Pleochroism	weak, greenish yellow and yellow, or differentes tones of yellow
Flourescence	inert
Absorption spectra	line at 537 nm
Specific gravity	2.72 (+ .18, -.05)
Fracture	conchoidal, with vitreous to resinous luster
Cleavage	very dificult in one direction, almost never seen
Identifying characteristics	liquid, two-phase or tubular inclusions
Possible treatments	yellow beryl becomes colorless under temperature between 400 and 450°C
Possibly mistaken with	quartz, labradorite, fluorite, scapolite, chrysoberyl and topaz
Hardness	7.5 – 8

STABILITY

Reaction to heat	may fracture if it contains liquid inclusions
Stability to light	color may fade
Reaction to chemicals	resistant to all acids expect hydrofluoric

Hematite

Mineral class	oxides
Group	hematite
Mineral species	hematite
Crystal system	hexagonal (trigonal)
Chemical composition	Fe_2O_3
Trade names	hematite; misnomers: black diamond, black pearl, alaskan black diamond
Color	dark gray to black
Transparency	opaque
Luster	metallic
Optical phenomena	none
Refractive Indices	2.940 - 3.220 (- .070)
Optic character	DR
Birefringence	.280
Dispersion	none
Pleochroism	none
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	5.20 (± .08, - .25)
Fracture	splintery, granular or subconchoidal, with dull luster
Cleavage	none
Identifying characteristics	streak and fracture surface commoly brownish red; none to moderate magnetism
Possible treatments	unknown
Possibly mistaken with	cassiterite and hematite imitation
Hardness	5.5 - 6.5

STABILITY

Reaction to heat	may become magnetic
Stability to light	stable
Reaction to chemicals	soluble in hydrochloric acid

Howlite

Mineral class	silicates
Mineral species	howlite
Crystal system	monoclinic
Chemical composition	$Ca_2B_5SiO_9(OH)_5$
Trade names	howlite
Color	white, often with dark gray and black matrix
Transparency	semitranslucent to opaque
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.586 – 1.605 (± .003), "spot" reading usually 1.59
Optic character	AGG; DR
Birefringence	.019 (usually not detectable)
Pleochroism	none
Flourescence	inert to moderate; orange (LW), brownish yellow (SW)
Absorption spectra	not diagnotic
Specific gravity	2.58 (- .13)
Fracture	granular, with dull luster
Cleavage	none
Identifying characteristics	may present spiderweb matrix
Possible treatments	blue dyeing
Possibly mistaken with	turquoise, lapis lazuli, pectolite, ivory and coral
Hardness	3 – 3.5

STABILITY

Reaction to heat	fusible under jeweler's torch
Stability to light	stable
Reaction to chemicals	dissolves in hydrochloric acid

Hydrogrossular Garnet

Mineral class	silicates
Group	garnet
Mineral species	hydrogrossular
Crystal system	cubic
Chemical composition	$Ca_3Al_2(SiO_4)_{3-x}(OH)_{4x}$
Trade names	hydrogrossular; misnomers: Transvaal jade and african jade
Color	green to bluish green, pink, white and gray
Transparency	translucent to opaque
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.720 (+ .01. - .050)
Optic character	SR, AGG
Birefringence	none
Dispersion	none
Pleochroism	none
Flourescence	inert
Absorption spectra	dark green material often shows a cutoff below 460 nm; other colors may show a line around 463 nm (due to some idocrase content)
Specific gravity	3.47 (+ .08, - .32)
Fracture	uneven, granular, splintery, with greasy to vitreous luster
Cleavage	none
Identifying characteristics	may have black, peppery looking inclusions
Possible treatments	unknown
Possibly mistaken with	idocrase, jadeite, nephrite, rhodonite, saussurite, rhodochrosite, zoisite, thulite and unakite
Hardness	7

STABILITY

Reaction to heat	abrupt temperature changes may cause fracturing
Stability to light	stable
Reaction to chemicals	very slightly attacked by hydrofluoric acid

Indicolite Tourmaline

Mineral class	silicates
Group	tourmaline
Mineral species	elbaite
Crystal system	trigonal
Chemical composition	$(Ca,K,Na)(Al,Fe,Li,Mg,Mn)_3(Al,Cr,Fe,V)_6(BO_3)_3Si_6O_{18}(OH,F)_4$
Variety	indicolite, cat's-eye indicolite and color change indicolite
Trade names	indicolite, indigolite, cat's-eye indicolite and color change indicolite; misnomers: brazilian sapphire
Color	purplish blue to greenish blue
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	chatoyancy and color change (rare)
Refractive Indices	1.624 - 1.644 (+ .011, - .009)
Optic character	uniaxial negative, DR
Birefringence	.018 a .040
Dispersion	.017
Pleochroism	strong to moderate, generally different blue tones
Flourescence	generally inert
Absorption spectra	almost complete absorptions of the red down to 640 nm, in addition to a strong narrow band at 498 nm
Specific gravity	3.06 (+ .2. - .06)
Fracture	conchoidal, with vitreous luster
Cleavage	none
Identifying characteristics	gaseous and liquid inclusions
Possible treatments	irradiation, thermal treatment
Possibly mistaken with	lazulite, apatite and iolite
Hardness	7 - 7.5

STABILITY

Reaction to heat	strong heat may alter color; sudden temperature change (heating or cooling) may cause fracturing
Stability to light	stable
Reaction to chemicals	none

Iolite

Mineral class	silicates
Mineral species	cordierite
Crystal system	orthorhombic
Chemical composition	$Mg_2Al_4Si_5O_{18}$
Variety	aventurine iolite and iolite
Trade names	dichroite, iolite, cordierite, aventurine iolite, bloodshot iolite; misnomers: water sapphire
Color	light to dark blue to violet (may occur in colorless, yellowish white, green, gray or brown samples, but these are seldom used for gem purposes)
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	rare: asterism, aventurescence and chatoyancy
Refractive Indices	1.542 - 1.551 (+ .045, - .011)
Optic character	biaxial negative, DR
Birefringence	.008 to .012
Dispersion	.017
Pleochroism	• violet - strong; light violet, dark violet and brown-yellow • blue - strong; colorless to yellow, gray-blue and dark violet
Flourescence	inert
Absorption spectra	weak bands at 645 and 426 nm
Specific gravity	2.61 (± .05)
Fracture	conchoidal to irregular, with vitreous luster
Cleavage	distinct in one direction
Identifying characteristics	eye-visible pleochroism and color zoning
Possible treatments	unknown
Possibly mistaken with	sapphire, amethyst, scapolite, tourmaline and tanzanite
Hardness	7 - 7.5

STABILITY

Reaction to heat	fusible
Stability to light	stable
Reaction to chemicals	attacked by acids

Jade (Jadeite)

Mineral class	silicates
Group	pyroxene
Mineral species	jadeite
Crystal system	monoclinic
Chemical composition	$NaAlSi_2O_6$
Variety	jadeite
Trade names	imperial jade, precious jade, emerald jade, jadeite, apple green jade, chloromelanite, Yunan jade, kidney stone and albite jade
Color	green, yellow to reddish orange, brown, white, gray, black, light purple (lavender); often mottled
Transparency	semitransparent to opaque
Luster	vitreous to greasy
Optical phenomena	none
Refractive Indices	1.666 - 1.680 (± .008); "spot" reading: usually 1.66
Optic character	AGG; DR
Birefringence	usually not detectable
Flourescence	light green - inert to weak white (LW), generally inert (SW); light yellow - inert to weak green (LW), generally inert (SW); white - inert to weak yellow (LW), generally inert (SW); light purple - inert to weak white or weak brownish red (LW), generally inert (SW); some dyed lavender jadeite - moderate to strong orange (LW), weaker (SW); dark colors - generally inert (LW e SW)
Absorption spectra	generally one line at 437 nm; natural green - sequence of lines at 630, 655, and 690 nm; dyed green - a single broad band in the region occupied by the three lines in natural green samples
Specific gravity	3.34 (+ .06, - .09)
Fracture	splintery to granular, with dull luster
Cleavage	not visible due to aggregate structure
Identifying characteristics	shiny reflections from individual crystals on unpolished backs of larger-grained stones; wavy surface; black inclusions and fracture
Possible treatments	dyeing, often preceded by heating to "open pores" (to add a green or lavender color in white or light colored material); colorless impregnation, especially with paraffin (hides fractures and improves polish appearance); heating (produces brown and reddish colors from material containing yellow to brown iron inclusions or rind)
Possibly mistaken with	nephrite, idocrase, hydrogrossular, chalcedony, serpentine, saussurite and maw-sit-sit
Hardness	6.5 - 7

STABILITY

Reaction to heat	fuses easily to a bubbly green glass under jeweler's torch or blowpipe
Stability to light	stable
Reaction to chemicals	slightly affected by warm acids

Jade (Nephrite)

Mineral class	silicates
Group	amphibole
Mineral species	actinolite-tremolite
Crystal system	monoclinic
Chemical composition	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$
Trade names	jade, nephrite, New Zealand greenstone and kidney stone; misnomers: russian jade (spinach green)
Color	light to dark green, yellow to brown, white, gray and black often mottled
Transparency	translucent to opaque
Luster	vitreous to greasy
Optical phenomena	none
Refractive Indices	1.606 - 1.632 (+ .009, - .006); "spot" reading: usually 1.61
Optic character	AGG; DR
Birefringence	usually not detectable
Dispersion	none
Pleochroism	none
Flourescence	inert
Absorption spectra	rarely shows any absorption lines; a diffuse line may be visible at 500 nm. Diffuse lines in the red end of the spectrum may be rarely seen in green stones of exceptional quality
Specific gravity	2.95 (+ .15, - .05)
Fracture	splintery to granular, with dull luster
Cleavage	not visible due to aggregate structure
Identifying characteristics	may have black inclusions, fibrous texture
Possible treatments	dyeing (to produce or improve color in light colored material); wax and paraffin impregnation (fills and hides surface cracks); heating (lightens color of dark green material)
Possibly mistaken with	jadeite, serpentine, hydrogrossular, idocrase, chalcedony and maw-sit-sit
Hardness	6 - 6.5

STABILITY

Reaction to heat	fuses slowly under jeweler's torch or blowbipe
Stability to light	stable
Reaction to chemicals	slightly affected by warm acids

Jasper

Mineral class	silicates
Mineral species	cryptocrystalline quartz
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Variety	chalcedony
Trade names	jasper and chalcedony
Color	virtually all colors; usually red, yellow or brown
Transparency	semitranslucent to opaque
Luster	greasy to vitreous
Optical phenomena	none
Refractive Indices	1.535 - 1.539
Optic character	AGG
Birefringence	usually not detactable, but may show .004
Dispersion	none
Pleochroism	none
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	2.60 (+ .10 - .05)
Fracture	conchoidal, sometimes granular, with dull to waxy luster
Cleavage	none
Identifying characteristics	mineral inclusions (hematite, goethite, etc), acting like a coloring agent
Possible treatments	dyeing; yellow to brown material turns to red due to thermal treatment
Possibly mistaken with	other chalcedony materials
Hardness	6.5 - 7

STABILITY

Reaction to heat	color may change
Stability to light	stable
Reaction to chemicals	attacked by hydrofluoric acid; nitric acid may attack dye

Lapis Lazuli

Crystal system	is a rock, not a sole mineral
Chemical composition	varies depending on mineral content; rock composed primarlly of lazurite, calcite and pyrite (may also contain hauyne, sodalite, with small amounts of diopside, augite, mica and hornblende)
Trade names	lapis lazuli, afghan lapis, russian lapis, siberian lapis, chilean lapis and oriental lapis
Color	medium to dark slightly greenish blue to violetish blue, often veined or flecked with brassy looking pyrite, and/or white to gray calcite inclusions
Transparency	semitranslucent to opaque
Luster	waxy to vitreous
Optical phenomena	none
Refractive Indices	vague reading around 1.50 and, sometimes, 1.67, due to calcite
Optic character	AGG
Pleochroism	none
Flourescence	weak to moderate green or yellowish green (SW); calcite inclusions may fluoresce pink (LW)
Absorption spectra	not diagnostic
Specific gravity	2.75 (± .25) varies depending on mineral content
Fracture	granular, uneven, with dull luster
Cleavage	none
Identifying characteristics	commonly contains pyrite and white calcite, white to light blue streak, distinctive fluorescence; rarely shows striated or "banded" structure
Possible treatments	dyeing (improves color, disguises calcite inclusions); paraffin coating or impregnation, oiling (to Improve polish appearance, also to conserve dyeing)
Possibly mistaken with	Gilson imitation lapis lazuli, dyed lapis lazuli, blue dyed chalcedony, blue dyed howlite, sodalite, azurite, azurmalachite, lazulite and other imitations
Hardness	5 - 6 , varies with impurities

STABILITY

Reaction to heat	light colored stones sometimes darken and improve in appearance when brought to a dull-red heat, but an undesirable green may be produced. If heated strongly, it will lose all color.
Stability to light	stable
Reaction to chemicals	decomposed slowly by hydrochloric acid, giving off the odor of rotten eggs (hydrogen sulfide). calcite matrix effervesces. cyanide solution causes a reddish brown discoloration.

Lazulite

Mineral class	phosphates
Group	lazulite
Mineral species	lazulite
Crystal system	monoclinic
Chemical composition	$MgAl_2(PO_4)_2(OH)_2$
Trade names	blue spar and lazulite
Color	medium to dark greenish blue to violetish blue
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.612 - 1.643 (± .005)
Optic character	biaxial negative, DR; AGG
Birefringence	.031
Dispersion	none
Pleochroism	strong - dark purplish blue and colorless to light blue
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	3.09 (+ .08, - .01)
Fracture	irregular to granular, with vitreous to dull luster
Cleavage	indistinct in one direction, rarely seen
Identifying characteristics	massive material mottled with white grains; strong pleochroism in transparent material
Possible treatments	unknown
Possibly mistaken with	azurite, lapis lazuli, sodalite, turquoise, tourmaline, apatite and benitoite
Hardness	5 - 6

STABILITY

Reaction to heat	sensitive
Stability to light	stable
Reaction to chemicals	may be attacked slowly by hot acids

Malachite

Mineral class	carbonates
Mineral species	malachite
Crystal system	monoclinic
Chemical composition	$Cu_2CO_3(OH)_2$
Trade names	peacock stone and malachite
Color	vivid hues, bluish green to green, usually banded in two or more tones of green; may have a sheen
Transparency	generally opaque
Luster	vitreous to silky
Optical phenomena	none
Refractive Indices	1.655 - 1.909
Optic character	DR; AGG
Birefringence	.254
Dispersion	none
Pleochroism	none
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	3.95 (+ .15, - .70)
Fracture	irregular to splintery, with dull luster
Cleavage	perfect in two directions, but usually obscured
Identifying characteristics	curved or angular banding; may have radial fibrous structure and sheen; may be botryoidal; light green streak
Possible treatments	impregnation with paraffin or epoxy resin - improves polish and hides small cracks
Possibly mistaken with	chlorastolite, dyed onyx marble, azurmalachite and synthetic malachite
Hardness	3.5 - 4

STABILITY

Reaction to heat	sensitive
Stability to light	stable
Reaction to chemicals	attacked by acids

Malaya and Color Change Garnets

Mineral class	silicates
Group	garnet
Mineral species	mixture of spessartine with pyrope
Crystal system	cubic
Chemical composition	$(Mg,Mn)_3Al_2(SiO_4)_3$
Variety	Malaya garnet and color change garnet
Trade names	Malaya garnet and color change garnet
Color	Malaya – light to dark slightly pinkish orange, reddish orange, yellowish orange; color change - wide variability in color behaviour from daylight to incandescent lighting, but predominantly blue hues
Transparency	transparent
Luster	vitreous to subadamantine
Optical phenomena	color change
Refractive Indices	1.760 (+ .02. - .018)
Optic character	SR, often ADR
Birefringence	none
Pleochroism	none
Flourescence	inert
Absorption spectra	Malaya garnet – strong lines at 410, 420, 430 nm (ocasionally merge to form a cutoff below 435 nm), also shows some combination of lines at 460, 480, 504, 520 and 573 nm color change garnet - similar to Malaya, but with a broad band centered around 570 nm
Specific gravity	3.78 to 3.85
Fracture	conchoidal, with vitreous luster
Cleavage	none, but may show indistinct parting
Identifying characteristics	rutile, pyrite and apatite inclusions
Possible treatments	unknown
Possibly mistaken with	Malaya garnet – almandine, pyrope, hessonite, spessartine, natural and synthetic sapphire; color change garnet – natural and synthetic alexandrite, natural and synthetic color change sapphire
Hardness	7 – 7.5

STABILITY

Reaction to heat	abrupt temperature changes likely tocause fracturing
Stability to light	stable
Reaction to chemicals	slightly attacked by hydrofluoric acid

Marcasite

Mineral class	sulphides
Group	marcasite
Mineral species	marcasite
Crystal system	orthorhombic
Chemical composition	FeS_2
Trade names	marcasite; misnomers: white pyrite, specular pyrite, iron pyrite, cellular pyrite, hepatic pyrite, lamellar pyrite and rhombic pyrite
Color	light yellow to whitish
Transparency	opaque
Luster	metallic
Optical phenomena	none
Refractive Indices	unavailable
Optic character	RD, AGG
Birefringence	unavailable
Pleochroism	unavailable
Flourescence	unavailable
Absorption spectra	unavailable
Specific gravity	4,85 to 4,92
Fracture	irregular
Cleavage	distinct in one diretion
Identifying characteristics	greenish black streak, not magnetic; corrosion spots may present iridescence
Possible treatments	unknown
Possibly mistaken with	pyrite and hematite
Hardness	6.0 – 6.5

STABILITY

Reaction to heat	fusible under jeweler's torch
Stability to light	stable
Reaction to chemicals	attackd by nitric acid

Microcline Feldspar

Mineral class	silicates
Group	feldspar
Mineral species	microcline
Crystal system	triclinic; prismatic and twinned crystals are frequent
Chemical composition	$KAlSi_3O_8$
Variety	amazonite
Trade names	amazonite, microcline and amazon stone
Color	light green to bluish green, white; ocasionally light orange to pink
Transparency	semitranslucent to opaque
Luster	vitreous to greasy
Optical phenomena	adularescence (rare)
Refractive Indices	1.522 - 1.530 (± .004)
Optic character	biaxial negative, usually AGG
Birefringence	.008 (usually undetectable)
Dispersion	.012
Pleochroism	none
Flourescence	inert to weak, yellowish green (LW)
Absorption spectra	not diagnostic
Specific gravity	2.56 (± .02)
Fracture	uneven to splintery with vitreous to pearly luster
Cleavage	perfect and easy in two directions
Identifying characteristics	mottled texture and shimmering effect on polished surfaces (more evident when the stone is rotated), due to reflections from incipient cleavage cracks; color centers involving lead and water concentrations
Possible treatments	color can be intensified by irradiation; wax, paraffin or oil impregnation, hardener agents to improve appearence
Possibly mistaken with	jade, chalcedony, aventurine quartz and turquoise
Hardness	6 - 6.5

STABILITY

Reaction to heat	may crack, cleave or lose color
Stability to light	stable
Reaction to chemicals	readily attacked by hydrofluoric acid; impurities may be attacked by other acids

Moldavite

Group	natural glass - tektite
Type	moldavite
Crystal system	amorphous
Chemical composition	variable - 75% SiO_2 + 13% Al_2O_3, potassium, iron, magnesium and sodium oxides
Trade names	moldavite; misnomers: glass meteorite, watery chrysolite, pseudochrysolite, false chrysolite and bohemian chrysolite
Color	medium to dark yellowish green to grayish green
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.490 (+ .020 - .010)
Optic character	SR, ADR is common
Birefringence	none
Dispersion	none
Pleochroism	none
Flourescence	generally inert
Absorption spectra	not diagnostic
Specific gravity	2.36 (± .04)
Fracture	conchoidal, with vitreous luster
Cleavage	none
Identifying characteristics	natural inclusions, gas bubbles, flow structures, "heat wave" effect, needle-like inclusions; can have numerous orientated inclusions that cause a sheen
Possible treatments	unknown
Possibly mistaken with	other natural glasses, man-made glasses, opal, chalcedony and smoky quartz
Hardness	5 - 5.5

STABILITY

Reaction to heat	may crack or break under fast temperature changes; merge under relatively low temperature.
Stability to light	stable
Reaction to chemicals	attacked by hydrofluoric acid

PS: Natural glass, probably formed by meteoritic impact.

Morganite

Mineral class	silicates
Mineral species	beryl
Crystal system	hexagonal
Chemical composition	$Be_3Al_2Si_6O_{18}$
Variety	morganite
Trade names	morganite and pink beryl
Color	pink, light reddish orange (salmon) to light purplish red
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	chatoyancy and asterism (rare)
Refractive Indices	1.577 - 1.583 (+ .017)
Optic character	uniaxial negative, DR
Birefringence	.005 to .009
Dispersion	.014
Pleochroism	weak to moderate, usually light red to purple-red
Flourescence	inert to weak, pink or light violet (LW e SW)
Absorption spectra	not diagnostic
Specific gravity	2.72 (+ .18, - .05)
Fracture	conchoidal, with vitreous to resinous luster
Cleavage	very difficult in one direction, almost never seen
Identifying characteristics	relatively free of inclusions; healing planes, liquid, tubular, two-phase and mineral inclusions (albite, apatite, muscovite, tourmaline, columbite and monazite)
Possible treatments	thermal treatment at 400 to 450^{0}C range to remove the yellow component, resulting in a pure pink color (sometimes reversible); samples from determined origins get a intense blue color by irradiation
Possibly mistaken with	kunzite, topaz, scapolite, apatite, tourmaline, fluorite and pink sapphire
Hardness	7.5 - 8

STABILITY

Reaction to heat	stable except at temperatures over 400^{0}C
Stability to light	stable
Reaction to chemicals	resistant to all acids except hydrofluoric

Obsidian

Group	volcanic natural glass
Crystal system	amorphous
Chemical composition	77% SiO_2 + 10-18% Al_2O_3
Variety	rainbow obsidian, cat's-eye obsidian, snowflake obsidian
Trade names	obsidian, rainbow obsidian, cat's-eye obsidian, snowflake obsidian, volcan glass; misnomers: black agate, Iceland agate and pseudochrysolite
Color	gray to black often spotted with white, brown to brownish yellow, orange or red; rarely green, blue and purple
Transparency	from transparent to opaque
Luster	vitreous
Optical phenomena	iridescence and chatoyancy (rare)
Refractive Indices	1.490 (+ .02. - .010)
Optic character	SR, AGG
Birefringence	none
Pleochroism	none
Flourescence	generally inert
Absorption spectra	not diagnostic
Specific gravity	2.40 (+ .10 - .07)
Fracture	conchoidal, with vitreous luster
Cleavage	none
Identifying characteristics	gas bubbles, chrystallites, stubby needle-like inclusions; my be banded or have numerous orientated inclusions that cause a sheen
Possible treatments	unknown
Possibly mistaken with	modalvite, opal, glass and chalcedony
Hardness	5 – 5.5

STABILITY

Reaction to heat	may fracture or break due to rapid temperature changes; melts at relatively low temperature
Stability to light	stable
Reaction to chemicals	attacked by hydrofluoric acid

Onyx

Mineral class	silicates
Mineral species	cryptocrystalline quartz
Variety	chalcedony
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Trade names	onyx
Color	made up of rectilinear and parallel layers with different colors, ex: white and black; white and brown, etc
Transparency	semitransparent to opaque
Luster	greasy to vitreous
Optical phenomena	none
Refractive Indices	1.535 - 1.539
Optic character	AGG
Birefringence	usually undetectable, but may show .004
Dispersion	none
Pleochroism	none
Flourescence	generally inert
Absorption spectra	not diagnostic
Specific gravity	2.60 (+ .10 - .05)
Fracture	conchoidal, sometimes granular, with dull to waxy luster
Cleavage	none
Identifying characteristics	rectilinear and parallel layers with different colors
Possible treatments	heat treatment and dyeing
Possibly mistaken with	black tourmaline, onyx-marble
Hardness	6.5 - 7

STABILITY

Reaction to heat	color may change
Stability to light	stable
Reaction to chemicals	attacked by hydrofluoric acid ; nitric acid may attack dye

Opal

Mineral class	silicates
Mineral species	opal
Crystal system	amorphous
Chemical composition	SiO_2nH_2O
Variety	precious opal, common opal, hyalite, fire opal and black opal
Trade names	white opal, black opal, fire opal, water opal, moss opal, hydrophane, etc
Color	white, grayish, blue, green, orange, black, colorless, red - virtually any body color
Transparency	transparent to opaque
Luster	vitreous to resinous
Optical phenomena	opalescence, opalization, asterism (rare) and chatoyancy (rare)
Refractive Indices	1.450 (+ .020 - .080), mexican opal may read as low as 1.37, but is generally 1.42 - 1.43
Optic character	SR; ADR common due to strain
Birefringence	none
Dispersion	none
Pleochroism	none
Flourescence	• white or black opal - inert to moderate, white to light blue, green or yellow (LW and SW); may phosphoresce • fire opal - inert to moderate, greenish brown (LW and SW); may phosphoresce • common opal - inert to strong, green or yellowish green (LW and SW); may phosphoresce
Absorption spectra	green - 660 nm, 470 nm (cut-off)
Specific gravity	2.15 (+ .08, - .90)
Fracture	conchoidal to irregular, with subvitreous to waxy luster
Cleavage	none
Identifying characteristics	play-of-color (iridescence) and various mineral inclusions
Possible treatments	dyeing; colorless and color impregnation; oil, wax or plastic Impregnation; black plastic Impregnation; sugar solution and sulphuric acid treatment; smoke impregnation, etc
Possibly mistaken with	synthetic opal, moldavite, obsidian, glass, fluorite, chalcedony and plastic imitation
Hardness	5 - 6.5

STABILITY

Reaction to heat	sudden changes in temperature may cause opals to crack, craze or fracture, overheating will turn most opals white or brownish, and the play-of-color will disappear
Stability to light	stable
Reaction to chemicals	attacked by hydrofluoric acid and caustic alkalies

Orthoclase Feldspar

Mineral class	silicates
Group	feldspar
Mineral species	orthoclase
Crystal system	monoclinic
Chemical composition	$KAlSi_3O_8$
Variety	moonstone
Trade names	adularia, moonstone and orthoclase
Color	colorless to white, ocasionally green, orange, yellow to brown, gray to nearly black
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	adularescence, asterism and chatoyancy
Refractive Indices	1.518 - 1.526 (+ .010)
Optic character	biaxial negative, DR
Birefringence	.005 - .008
Dispersion	.012
Pleochroism	usually none; transparent yellow samples may show weak to moderate pleochroism
Flourescence	moonstone – inert to blue (LW); orangish (SW); may fluoresce weak pink to moderate red (LW and SW)
Absorption spectra	not diagnostic for moonstone; yellow orthoclase: broad bands at approximately 420 and 448 nm
Specific gravity	2.58 (± .03)
Fracture	uneven to splintery, vitreous to pearly luster
Cleavage	perfect and easy in two directions; parting is also common
Identifying characteristics	moonstone - centipede-like inclusions (commonly an orthoclase-albite intergrowth with associated cleavages)
Possible treatments	blue or black coating on back (enhances adularescence)
Possibly mistaken with	milky chalcedony, petalite, scapolite and quartz
Hardness	6 - 6.5

STABILITY

Reaction to heat	may crack or cleave
Stability to light	stable
Reaction to chemicals	attacked by hydrofluoric acid

Paraiba Tourmaline

Mineral class	silicates
Group	tourmaline
Mineral species	elbaite
Crystal system	trigonal
Chemical composition	$(Ca,K,Na)(Al,Fe,Li,Mg,Mn)_3(Al,Cr,Fe,V)_6(BO_3)_3Si_6O_{18}(OH,F)_4$
Variety	Paraíba tourmaline, cat's-eye Paraíba tourmaline and color change Paraiba tourmaline
Trade names	Paraíba tourmaline, cat's-eye Paraiba tourmaline and color change Paraiba tourmaline
Color	blue to purplish blue, green, pink to purplish pink (vivid hues are commercially designated neon, fluorescent or eletric)
Transparency	transparent
Luster	vitreous
Optical phenomena	chatoyancy and color change
Refractive Indices	1.618 - 1.639 (± .001)
Optic character	uniaxial negative, DR
Birefringence	.018 to .025
Dispersion	.017
Pleochroism	strong to moderate, generally different color tones
Flourescence	none
Absorption spectra	weak and well defined band at 415 nm; variable intensity broad band centered at 515 nm; broad band which begins around 600 nm and fulfills the red region
Specific gravity	3.03 to 3.12 (+ .05, - .02)
Fracture	conchoidal, with vitreous luster
Cleavage	none
Identifying characteristics	three-phase inclusions, liquid inclusions, fingerprint-like inclusions and growth tubes orientated parallel to optical axis
Possible treatments	thermal treatment
Possibly mistaken with	tourmaline, emerald, synthetic spinel, glass imitations, demantoid, peridot, sapphire, lazulite, tanzanite, hauyne and apatite
Hardness	7 - 7.5

STABILITY

Reaction to heat	strong heat may alter color; sudden temperature change (heating ou cooling) may cause fracturing
Stability to light	stable
Reaction to chemicals	none

Peridot

Mineral class	silicates
Group	olivine
Mineral species	forsterite
Crystal system	orthorhombic
Chemical composition	$(Mg, Fe)_2SiO_4$
Variety	peridot
Trade names	chrysolite, hawaiite and peridot
Color	yellowish green to greenish yellow to brownish green
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	asterism (extremaly rare)
Refractive Indices	1.654 - 1.690 (± .020)
Optic character	biaxial positive or negative (the beta index is usually almost exactly halfway between the extremes), DR
Birefringence	.035 a .038, usually .036
Dispersion	.020
Pleochroism	weak, green-yellow and green; noticeable only in dark stones
Flourescence	inert
Absorption spectra	three narrow and strong bands at 453, 477 e 497 nm
Specific gravity	3.34 (+ .14, - .07)
Fracture	conchoidal, with vitreous to subvitreous luster
Cleavage	imperfect to distinct, in one diretion (rarely seen)
Identifying characteristics	disk-like liquid and gas Inclusions ("lilypads"); dark octahedral chromite crystals
Possible treatments	heat treatment - dark stones become lighter
Possibly mistaken with	demantoid, diopside, sinhalite, synthetic spinel, tourmaline, dioptase, zoisite and spodumene
Hardness	6.5 - 7

STABILITY

Reaction to heat	uneven or rapid heat may cause fracturing or complete breakage
Stability to light	stable
Reaction to chemicals	attacked easily by sulphuric acid and less easily by hidrofluoric acid. Acid perspiration of some people may attack over a long period of time. Pickling solution with etch surface.

Plagioclase Feldspar

Mineral class	silicate
Group	feldspar
Mineral species	labradorite and oligoclase
Crystal system	triclinic
Chemical composition	$NaAlSi_3O_8$ and $CaAl_2Si_2O_8$
Variety	labradorite - espectrolite, sunstone and albite; sunstone - oligoclase
Trade names	labradorite, sunstone, aventurine feldspar, oligoclase, albite and espectrolite
Color	• labradorite - from gray to almost black, colorless, green, yellow, orange to brown or brownish red • oligoclase - yellow, orange to brown or brownish red; sometimes colorless or from white to light green or gray
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	labradorescence, aventurescence; sometimes weak chatoyancy or asterism in labradorite
Refractive indices	labradorite - 1.559 - 1.568 (± .005) oligoclase - 1.537 - 1.547 (+ .004, - .006)
Optic character	DR, biaxial negative (oligoclase) and positive (labradorite); AGG reaction commom
Birefringence	.007 to .01. labradorite usually .009
Dispersion	none
Pleochroism	usually none; yellow samples: colorless and light yellow
Flourescence	usually inert, may be weak with white parts (LW and SW)
Absorption spectra	not diagnostic
Specific gravity	labradorite - 2.70 (± .05); oligoclase - 2.65 (+ .02, - .03)
Fracture	uneven to splintery with vitreous to pearly luster
Cleavage	perfect and easy in two directions; parting is also commom
Identifying characteristics	labradorite - repeated twinning, black needle-like inclusions, magnetite, zircon, fracture; oligoclase - red to golden metallic platelets (hematite or goethite); fracture
Possible treatments	unknown
Possibly mistaken with	labradorite - beryl, quartz, scapolite; sunstone - aventurine quartz, dyed quartz, goldstone and chalcedony
Hardness	6 - 6.5

STABILITY

Reaction to heat	may crack or cleave
Stability to light	stable
Reaction to chemicals	readily attacked by hydrofluoric acid, slowly attacked by hydrochloric acid

Pyrite

Mineral class	sulphides
Group	pyrite
Mineral species	pyrite
Crystal system	cubic
Chemical composition	FeS_2
Trade names	pyrite; misnomers: fool's gold and marcasite
Color	metallic light yellow
Transparency	opaque
Luster	metallic
Optical phenomena	none
Refractive Indices	over limits of refractometer (negative reading)
Optic character	SR
Birefringence	none
Dispersion	none
Pleochroism	none
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	5.00 (± .10)
Fracture	conchoidal to irregular, with metallic luster
Cleavage	none
Identifying characteristics	metallic yellow luster; greenish to brownish black streak; nonmagnetic; may have iridescent tarnish; twinning common in crystal specimens
Possible treatments	unknown
Possibly mistaken with	gold and marcasite
Hardness	6 – 6.5

STABILITY

Reaction to heat	fuses easily under the jeweler's torch
Stability to light	stable
Reaction to chemicals	soluble in acid nitric; surface oxidizes over time

Pyrope Garnet

Mineral class	silicates
Group	garnet
Mineral species	pyrope
Crystal system	cubic
Chemical composition	$Mg_3Al_2(SiO_4)_3$
Variety	chrome-pyrope
Trade names	garnet, pyrope and chrome-pyrope; misnomers: Cape ruby, Colorado ruby, Arizona ruby and bohemian garnet
Color	medium to dark orangish red; red to slightly purplish red, colorless (rare)
Transparency	transparent to semitranslucent (for very dark stones)
Luster	vitreous
Optical phenomena	color change (rare) from red to reddish purple (usually such stones are part pyrope and part spessartine)
Refractive Indices	1.714 to higher than 1.742, usually 1.74
Optic character	SR, often ADR
Birefringence	none
Dispersion	.022
Pleochroism	none, may exhibit color change due to strong tension
Flourescence	inert
Absorption spectra	broad band near 564 nm, cutoff at 440 to 445 nm range. Fine quality material may show chromium lines in the red end of the spectrum
Specific gravity	3.78 (+ .09, - .16)
Fracture	conchoidal, with greasy to vitreous luster
Cleavage	none, may have indistinct parting
Identifying characteristics	needle-like crystal Inclusions and rounded crystal inclusions
Possible treatments	unknown
Possibly mistaken with	almandine, natural and synthetic red spinel, natural and synthetic ruby, grossular, hessonite, rhodolite and garnet / glass doublet
Hardness	7 - 7.5

STABILITY

Reaction to heat	fuses easily under jeweler's torch; abrupt temperature changes likely to cause stone to fracture
Stability to light	stable
Reaction to chemicals	slightly attacked by hydrofluoric acid

Rhodochrosite

Mineral class	carbonates
Group	calcite
Mineral species	rhodochrosite
Crystal system	hexagonal (trigonal)
Chemical composition	$MnCO_3$
Trade names	rhodochrosite, spar and inca rose
Color	pink to red, often with bands or layers; may appear white, gray, brown or yellow in areas
Transparency	translucent to opaque
Luster	vitreous to subvitreous
Optical phenomena	none
Refractive Indices	1.597 - 1.817 (± .003)
Optic character	uniaxial negative, DR; AGG
Birefringence	.220
Dispersion	none
Pleochroism	aggregates - none; transparent crystals – moderate to strong, orangish yellow and red
Flourescence	inert to moderate pink (LW); inert to weak red (SW)
Absorption spectra	very strong band around 410 nm and weaker bands centered around 450 nm and 545 nm
Specific gravity	3.60 (+ .10 - .15)
Fracture	irregular to granular, with dull to vitreous luster
Cleavage	perfect in three directions, but usually osbscured by aggregate structure
Identifying characteristics	agate-like banding in aggregate material
Possible treatments	unknown
Possibly mistaken with	rhodonite and hydrogrossular
Hardness	3.5 - 4.5

STABILITY

Reaction to heat	turns to gray, brown or black; breakt into pieces under jeweler's torch
Stability to light	stable
Reaction to chemicals	efferverces with hydrochloric acid

Rhodolite Garnet

Mineral class	silicates
Group	garnet
Crystal system	cubic
Chemical composition	$[(Mg,Fe)_3Al_2(SiO_4)_3]$, intermediate member between pyrope and almandine
Variety	rhodolite
Trade names	rhodolite
Color	light to dark purplish red through reddish purple
Transparency	transparent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.760 (+ .010 - .020)
Optic character	SR, often ADR
Birefringence	none
Dispersion	.026
Pleochroism	none
Flourescence	inert
Absorption spectra	basically similar to almandine´s
Specific gravity	3.84 (± .10)
Fracture	conchoidal, with greasy to vitreous luster
Cleavage	none, may have indistrict parting
Identifying characteristics	needle-like rutile crystals (usually coarse), zircon crystals with tension halos, apatite crystals; and irregular, rounded included crystals of low relief
Possible treatments	unknown
Possibly mistaken with	almandine, pyrope, natural and synthetic pink corundum, garnet / glass doublet
Hardness	7 - 7.5

STABILITY

Reaction to heat	abrupt temperature changes likely to cause fracturing
Stability to light	stable
Reaction to chemicals	slowly attacked by hydrofluoric acid

Rhodonite

Mineral class	silicates
Mineral species	rhodonite
Crystal system	triclinic
Chemical composition	$(Mn,Fe,Mg,Ca)SiO_3$
Trade names	rhodonite; misnomers: pink marble
Color	pink to brownish or purplish red, often with splotches and black veins, may also have greenish or yellowish areas due to impurities
Transparency	translucent to opaque; transparent (rare)
Luster	vitreous to subvitreous
Optical phenomena	none
Refractive Indices	1.733 - 1.747 (+ .010 - .013), spot reading usually 1.73 but may be 1,54, due to quartz impurities
Optic character	biaxial positive, DR; AGG
Birefringence	.010 to .014
Dispersion	none
Pleochroism	none in aggregate material; transparent crystals - weak to moderate, orange-red and brownish red
Flourescence	none
Absorption spectra	broad band centered around 545 nm and a line in 503 nm
Specific gravity	3.50 (+ .26, - .20)
Fracture	conchoidal to irregular or granular, with dull to vitreous luster
Cleavage	perfect in two directions, but usually obscured by aggregate structure
Identifying characteristics	black veins and manganese oxide spots
Possible treatments	unknown
Possibly mistaken with	rhodochrosite (aggregates and transparent samples), thulite and hydrogrossular garnet
Hardness	5.5 - 6.5

STABILITY

Reaction to heat	fuses easily into a brownish or black glass under jeweler's torch
Stability to light	stable
Reaction to chemicals	slightly attacked by acids

Rock Crystal Quartz

Mineral class	silicates
Mineral species	quartz
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Variety	rainbow quartz (rock crystal containing many iridescent fractures)
Trade names	colorless quartz, rock crystal, rainbow quartz; misnomers: Herkimer diamond, Arizona diamond, Arkansas diamond, Alaska diamond
Color	colorless
Transparency	transparent
Luster	vitreous
Optical phenomena	iridescence
Refractive Indices	1.544 - 1.553
Optic character	uniaxial positive, DR
Birefringence	.009
Dispersion	.013
Pleochroism	none
Flourescence	inert
Absorption spectra	none
Specific gravity	2.66 (+ .03, - .02)
Fracture	conchoidal, with vitreous luster
Cleavage	none
Identifying characteristics	rutile, goethite, gold, pyrite, dendrite (iron and manganese oxides), chlorite, 2-phase and 3-phase inclusions, liquids, negative crystals, tourmaline, hematite and amphibole
Possible treatments	quench-crackling (heating and cooling quickly produces many fractures to create iridescent effects, or to allow penetration of dyes) - irradiation (produces smoky quartz from rock crystal) - dyeing (usually quench-crackled rock crystal)
Possibly mistaken with	beryl, phenakite, synthetic quartz and other colorless gems
Hardness	7

STABILITY

Reaction to heat	may fracture when subjected to abrupt temperature changes
Stability to light	stable
Reaction to chemicals	soluble in hydrofluoric acid and ammonium fluoride, very slightly soluble in alkalies

Rose Quartz

Mineral class	silicates
Mineral species	quartz
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Variety	rose quartz
Trade names	rose quartz
Color	pink, often very light in tone
Transparency	semitransparent to translucent
Luster	vitreous
Optical phenomena	asterism and chatoyancy
Refractive Indices	1.544 - 1.553
Optic character	uniaxial positive, DR
Birefringence	.009
Dispersion	.013
Pleochroism	weak to strong, different pink tones
Flourescence	inert to weak, purplish (SW)
Absorption spectra	not diagnostic
Specific gravity	2.66 (+ .03, - .02)
Fracture	conchoidal to irregular or granular, with vitreous luster
Cleavage	none
Identifying characteristics	color zoning, twinning, two-phase and three-phase inclusions
Possible treatments	irradiation - intensify color; cover or plate in cabochon´s bottom to improve color and/or induce star effect; dyeing - to improve the color of fractured samples
Possibly mistaken with	fluorite and scapolite
Hardness	7

STABILITY

Reaction to heat	may fracture when subjected to abrupt temperature changes; may lose or change color under high temperature
Stability to light	may lose color
Reaction to chemicals	soluble em hydrofluoric acid and ammonium fluoride; very slightly soluble em alkalies

Rubellite Tourmaline

Mineral class	silicates
Group	tourmaline
Mineral species	elbaite
Crystal system	hexagonal (trigonal)
Chemical composition	$(Ca,K,Na)(Al,Fe,Li,Mg,Mn)_3(Al,Cr,Fe,V)_6(BO_3)_3Si_6O_{18}(OH,F)_4$
Variety	rubellite, cat's-eye rubellite and color change rubellite
Trade names	rubellite, cat's-eye rubellite and color change rubellite
Color	pink to red; may be brownish red, orangish or purplish
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	chatoyancy and color change (rare)
Refractive Indices	1.624 - 1.644 (+ .011, - .009)
Optic character	uniaxial negative, RD
Birefringence	.018 a .040
Dispersion	.017
Pleochroism	moderate to strong, generally different color tones
Flourescence	inert to very weak, red to violet (LW e SW)
Absorption spectra	broad band in green region and lines at 458 and 451 nm
Specific gravity	3.06 (+ .20 - .06)
Fracture	conchoidal, with vitreous luster
Cleavage	none
Identifying characteristics	gaseous and liquid inclusions
Possible treatments	irradiation - pale colors change to pink or red, pink may change to orangish; heating - red to light red to colorless, brownish red to pink
Possibly mistaken with	ruby and topaz
Hardness	7 - 7.5

STABILITY

Reaction to heat	strong heat may alter color; sudden temperature change (heating or cooling) may cause fracturing
Stability to light	stable
Reaction to chemicals	none

Ruby

Mineral class	oxides
Group	hematite
Mineral species	corundum
Crystal system	hexagonal (trigonal)
Chemical composition	Al_2O_3
Variety	asteriated ruby (star ruby)
Trade names	• burmese or oriental ruby - red to slightly purplish red in medium dark tone and vivid saturation; generally considered finest color and traditionally designed "piggeon's blood" • beef blood ruby - slightly darker than pidgeon's blood color • french-color or cherry ruby - slightly lighter than pidgeon's blood color • thai, Siam or siamese ruby - dark red to brownish red or purplish red • Ceylon or Sri Lanka ruby - lighter in tone, and often more brighter than burmese or thai stones • african ruby (Umba river) - typically orangy red
Color	orangy red to purplish red, brownish red
Transparency	transparent to opaque
Luster	vitreous to subadamantine
Optical phenomena	asterism, chatoyancy (very rare)
Refractive Indices	1.762 - 1.770 (+ .009, - .005)
Optic character	uniaxial negative, DR
Birefringence	.008 to .010
Dispersion	.018
Pleochroism	strong, purplish red and orangish red
Flourescence	• burmese - strong red (LW), moderate red (SW), • Ceylon - strong orange-red (LW), moderate orange-red (SW), • thai - weak red (LW), inert (SW)

Absorption spectra	strong doublet at 694.2 and 692,8 nm which may appear as a fluorescent line, fairly distinct lines at 668 and 659.2 nm, broad absorption from 620 to 540 nm, a strong doublet at 476.5 and 475 nm, a weak line at 468.5, and general absorption of the violet
Specific gravity	4.00 (± .05)
Fracture	conchoidal to irregular, with vitreous luster
Cleavage	none, may show partition on twinned gems
Identifying characteristics	silk (fine needle-like rutile or bohemite crystals), rutile needles often arranged in three sets that intersect one another at 60º angles; zircon crystals usually surrounded by a halo of dark fractures; fingerprint inclusions, hexagonal growth lines and color zoning
Possible treatments	heating followed by controlled cooling, heating and slow cooling, diffusion (heating above 1900ºC in the presence of titanium oxide or other coloring agent), heat treatment; oil and dye, glass filling in cavities and cracks
Possibly mistaken with	synthetic ruby, red garnets, natural or synthetic spinel, sapphire / synthetic ruby doublet, natural ruby doublet and garnet / glass doublet
Hardness	9

STABILITY

Reaction to heat	sometimes improves color
Stability to light	stable
Reaction to chemicals	attacked with difficulty; may lose polish if boiled in a diamond cleaning solution; soldering flux or pickle solution contatiing boron can etch the surface of the stone

Rutilated Quartz

Mineral class	silicates
Mineral species	quartz
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Variety	rutilated quartz
Trade names	Venus hair stone, cupid's arrows, love arrows or fleches d'amour, thethis hair stone, cat's fur quartz, rutilated quartz and quartz sagenitic (general term referring to transparent quartz containing eye-visible needle-like inclusions)
Color	usually colorless with needle-like yellow, black or red Inclusions, metallic luster
Transparency	transparent
Luster	vitreous
Optical phenomena	It may occur chatoyancy due to rutile-needles orientations
Refractive Indices	1.544 - 1.553
Optic character	uniaxial positive, DR
Birefringence	.009
Dispersion	.013
Pleochroism	none
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	2.66 (+ .03, - .02)
Fracture	conchoidal to irregular or granular, with vitreous luster
Cleavage	none
Identifying characteristics	actionolite and rutile needle-like inclusions, liquids, negative crystals, two-phase and three-phase inclusions and fractures
Possible treatments	unknown
Possibly mistaken with	none
Hardness	7

STABILITY

Reaction to heat	may fracture when subjected to abrupt temperature changes
Stability to light	stable
Reaction to chemicals	soluble in hydrofluoric acid and ammonium fluoride; very slightly soluble in alkalies

Sapphire

Mineral class	oxides
Group	hematite
Mineral species	corundum
Crystal system	hexagonal (trigonal)
Chemical composition	Al_2O_3
Variety	color change sapphire, adamantine spar and asteriated sapphire (star sapphire)
Trade names	• golden sapphire; plum sapphire, jacinth sapphire; pink sapphire; green sapphire; colorless sapphire or leucosapphire; alexandrite-type sapphire (color change sapphire) • padparadscha sapphire - intense light to medium pinkish orange to pink-orange • Kashmir sapphire - velvety, slightly violetish blue, highly saturated in medium to medium dark tone (often described as cornflower blue), with sleepy transparency widely regarded as the finest quality blue sapphires • oriental or burmese sapphire - slightly violetish blue, highly saturated in medium to medium dark tone (often described as royal blue); may appear somewhat inky under incandescent light, but is still considered a very fine quality sapphire • Ceylon or Sri Lanka sapphire - fairly brilliant, light grayish to violetish blue • Siam, siamese or thay sapphire - dark blue; in England - an intense dark blue with a slightly velvety body appearance • Montana sapphire - highly transparent, mostly light in tone, with color described as “steely” blue • african sapphire - typically light in tone • australian sapphire - very dark and inky, often with a strong green dichroic color • gueda sapphire - milky appearing gem from Sri Lanka whichh may develop a blue color when heat treated • misnomers: oriental topaz, king topaz, imperial topaz, oriental emerald, oriental amethyst, oriental aquamarine, aquamarine sapphire, amethyst sapphire
Color	green, yellow, pink, purple, violet, brown, black, gray, colorless, purplish blue to greenish blue, in very light to very dark tones
Transparency	from transparent to opaque
Luster	vitreous to subadamantine
Optical phenomena	asterism, chatoyancy (very rare), color change
Refractive Indices	1.762 - 1.770 (+ .009, - .005)
Optic character	uniaxial negative, DR
Birefringence	de .008 a .010

Dispersion	.018
Pleochroism	• purple or violet - strong, violet and orange • green - strong, green and yellowish green • yellow - weak, yellow and light yellow • orange - strong, brown-yellow or orange and colorless • blue - moderate to strong, purplish blue and greenish blue
Flourescence	• pink - strong orange-red (LW), weak orange-red (SW) • orange - usually inert, may be red-orange strong (LW) • yellow - inert to moderate red-orange to yellow-orange (LW), weak red to orange-yellow (SW) • green - inert • violet and color change - inert to moderate strong red (LW), weaker (SW) • colorless - inert to moderate red to orange (LW e SW) • brown - usually inert, may be weak red (LW e SW) • black - inert • heat treated blue - sometimes chalky green (SW) • blue (some african) - moderate to strong orangy (SW) • blue (some thai) - greenish white (SW) • dark blue - usually inert, may be moderate red (LW e SW) • Ceylon light blue - moderate to strong orange to red (LW), weaker (SW) • blue (others) - virtually inert
Absorption spectra	• green - 450, 460 and 470 nm • yellow (australian) - 450, 460 nm • orangy yellow from Australia and other sources - no typical spectra • purple - varying traces and combinations of iron, titanium and chromium • blue - 3 bands at approximately 450, 460 and 470 nm; in australian stones, the 3 bands are usually distinct, but in ceylonese stones only the 450 line is usually visible; Kashmir stones seldom show any lines; heat-treated stones often show no lines or only a faint line at 450 nm
Specific gravity	4.00 (+ .10 - .05)
Fracture	conchoidal, with vitreous luster
Cleavage	none, twinned stones may show parting
Identifying characteristics	silk (fine needle-like rutile or bohemite crystals), rutile needles often arranged in three sets that intersect one another at 60º angles; zircon crystals usually surrounded by a halo of dark fractures; fingerprint inclusions, hexagonal growth lines and color zoning
Possible treatments	heating followed by controlled cooling, heating and slow cooling, diffusion (heating above 1900ºC in the presence of titanium oxide or other coloring agent), heat treatment; oil and dye, glass filling in cavities and cracks

Possibly mistaken with ▸	synthetic sapphire, garnet, chrysoberyl, natural or synthetic spinel, natural sapphire / synthetic sapphire doublet, garnet / glass doublet, tanzanite, iolite, benitoite and kyanite
Hardness ▸	9

STABILITY

Reaction to heat ▸	sometimes improve color, may remove color
Stability to light ▸	stable
Reaction to chemicals ▸	attacked with difficulty; may lose polish if boiled in a diamond-cleaning solution. Soldering flux or pickiling solution containing borax will etch the surface of the stone

Scapolite

Mineral class	silicates
Group	scapolite
Mineral species	scapolite
Crystal system	tetragonal
Chemical composition	(variable) $Na_4Al_3Si_9O_{24}Cl$ a $Ca_4Al_6Si_6O_{24}(CO_3,SO_4)$
Trade names	scapolite and by color; erroneous: pink moonstone
Color	colorless, pink, orange, yellow, green, blue, violet and purple
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	chatoyancy (rare)
Refractive Indices	1.550 - 1.564 (+.015, - .014)
Optic character	uniaxial negative, RD
Birefringence	.004 to .037; increases as RI increases
Dispersion	.017
Pleochroism	pink, purple and violet samples - moderate to strong, blue and bluish purple yellow samples - weak to moderate, different yellow tones
Flourescence	inert to strong, on pink, orange or yellow color (LW and SW)
Absorption spectra	pink samples - lines at 663 and 652 nm
Specific gravity	2.60 to 2.74
Fracture	conchoidal with a vitreous luster
Cleavage	perfect in two directions
Identifying characteristics	combination of properties
Possible treatments	irradiation
Possibly mistaken with	iolite, beryl, quartz, labradorite and orthoclase
Hardness	6 - 6.5

STABILITY

Reaction to heat	fuses easily
Stability to light	stable, except irradiated purple stones
Reaction to chemicals	attacked by acids

Serpentine

Mineral class	silicates
Group	serpentine
Mineral species	serpentine
Crystal system	monoclinic
Chemical composition	$(Mg,Fe,Ni)_3Si_2O_5(OH)_4$
Variety	antigorite, bowenite and williamsite
Trade names	serpentine, bowenite, williamsite, antigorite and verd-antique; misnomers: korean jade, new jade, Soochow jade and styrian jade
Color	green to greenish yellow, white, brown, black; often mottled
Transparency	semitranslucent to opaque
Luster	waxy to vitreous
Optical phenomena	none
Refractive Indices	1.560 - 1.570 (+ .004, - .070)
Optic character	AGG; DR
Birefringence	usually undetectable
Dispersion	none
Pleochroism	none
Flourescence	inert to weak green (LW)
Absorption spectra	not diagnostic
Specific gravity	2.57 (+ .23, - .13)
Fracture	granular to irregular, with waxy to dull luster
Cleavage	none
Identifying characteristics	black inclusions (chromite octahedra), white veining, moss-like inclusions, fibres and fracture
Possible treatments	dyeing (produces various colors); wax impregnation (fills and hides pores and surface cracks, improving appearance)
Possibly mistaken with	jadeite, chalcedony, nephrite, variscite and green turquoise
Hardness	2.5 - 6; bowenite and williamsite toward the harder end

STABILITY

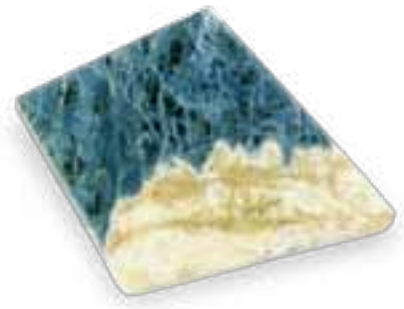
Reaction to heat	fuses with dificulty under jeweler's torch
Stability to light	stable
Reaction to chemicals	descomposed by hydrochloric acid and sulphuric acid

Smoky Quartz

Mineral class	silicates
Mineral species	quartz
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Variety	smoky quartz
Trade names	smoky quartz, "fumê" quartz, morion (very dark samples); misnomers: smoky topaz , burnt topaz, scotch topaz
Color	light to dark brown, sometimes black nearly opaque
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	iridescence
Refractive Indices	1.544 - 1.553
Optic character	uniaxial positive, DR
Birefringence	.009
Dispersion	.013
Pleochroism	weak - brown and reddish brown in dark gems; light to dark brown-yellow in lighter gems
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	2.66 (+ .03, - .02)
Fracture	conchoidal to irregular or granular, with vitreous luster
Cleavage	none
Identifying characteristics	negative crystals, two-phase and three-phase inclusions, fractures, liquids and color zoning
Possible treatments	quench-crackling (heating and cooling quickly produces many fractures to create iridescent effects, or to allow penetration of dyes); irradiation (produces smoky quartz from rock crystal); heat treatment (lightens color of very dark smoky quartz; irradiation - intensify color; cover or plate in cabochon´s bottom to improve color
Possibly mistaken with	andalusite, axinite, orthoclase, tourmaline and vesuvianite
Hardness	7

STABILITY

Reaction to heat	may fracture when subjected to abrupt temperature changes; may lose or change color under high temperature
Stability to light	stable
Reaction to chemicals	soluble in hydrofluoric acid and ammonium fluoride, very slightly soluble em alkalies



Sodalite

Mineral class	silicates
Group	sodalite
Mineral species	sodalite
Crystal system	cubic
Chemical composition	$Na_8Al_6Si_6O_{24}Cl_2$
Variety	hackmanite
Trade names	sodalite and hackmanite; misnomers: canadian blue stone
Color	dark blue to violetish blue, often with white veining (may be also yellow or red); rarely grayish, greenish, yellowish, white or pink
Transparency	translucent to opaque
Luster	vitreous to greasy
Optical phenomena	none
Refractive Indices	1.483 (± .004)
Optic character	AGG; SR
Birefringence	none
Dispersion	none
Pleochroism	none
Flourescence	Inert to weak, patchy orangish (LW)
Absorption spectra	only with intense transmitted light - line at 540 nm, band around 590 to 604 nm and broad band around 655 to 695 nm
Specific gravity	2.25 (+ .15, - .10)
Fracture	irregular to subconchoidal, with vitreous to greasy luster
Cleavage	distinct in six directions, but usually obscured by aggregate structure
Identifying characteristics	white veining commom; pyrite grains are rare
Possible treatments	unknown
Possibly mistaken with	lapis lazuli, azurite, dumortierite quartz, hauyne, lazulite and dyed jasper
Hardness	5 - 6

STABILITY

Reaction to heat	fuses to a colorless glass
Stability to light	pink fades; otherwise stable
Reaction to chemicals	attacked by hydrochloric acid

Spessartine Garnet

Mineral class	silicates
Group	garnet
Mineral species	spessartine
Crystal system	cubic
Chemical composition	$Mn_3Al_2(SiO_4)_3$
Trade names	spessartine and garnet
Color	yellowish orange to reddish orange
Transparency	transparent
Luster	vitreous to subadamantine
Optical phenomena	none
Refractive Indices	1.810 (+ .004, - .020)
Optic character	SR, often ADR
Birefringence	none
Dispersion	.027
Pleochroism	none
Flourescence	inert
Absorption spectra	bands at 410, 420 and 430 nm (ocasionally merge to form cutoff below 430 nm); also bands at 460, 480 and 520 nm; sometimes weak bands at 504 and/or 573 nm
Specific gravity	4.15 (+ .05, - .03)
Fracture	conchoidal, with vitreous luster
Cleavage	none, but may show indistinct parting
Identifying characteristics	wavy irregular feather-like liquid inclusions, two-phase inclusions, negative crystals and growth structures
Possible treatments	unknown
Possibly mistaken with	almandine, malaya garnet, hessonite, sphalerite, colored cubic zirconia, colored YAG and colored GGG
Hardness	7 - 7.5

STABILITY

Reaction to heat	abrupt temperature changes likely to cause fracturing
Stability to light	stable
Reaction to chemicals	very slowly attacked by hydrofluoric acid

Sphene

Mineral class	silicates
Mineral species	sphene or titanite
Crystal system	monoclinic
Chemical composition	$CaTiSiO_5$
Variety	chrome sphene
Trade names	titanite, sphene and chrome sphene
Color	yellow, green, brown, orange, rarely red, non-gemmy material gray to black
Transparency	from transparent to translucent
Luster	adamantine to subadamantine
Optical phenomena	none
Refractive Indices	1.900 - 2.034 (±.020)
Optic character	DR, biaxial positive
Birefringence	.100 to .135
Dispersion	.051
Pleochroism	yellow and brown samples - moderate to strong, light yellow, brownish orange and brownish yellow
Flourescence	inert
Absorption spectra	sometimes presents doublet at 580 nm
Specific gravity	3.52 (±.02)
Fracture	conchoidal to fibrous, with an adamantine to resinous luster
Cleavage	distinct in two directions
Identifying characteristics	strong doubling, strong dispersion; twinning is commom
Possible treatments	unknown
Possibly mistaken with	synthetic rutile, zircon, sphalerite, scheelite, cassiterite, andradite, CZ, GGG and YAG
Hardness	5 - 5.5

STABILITY

Reaction to heat	very sensitive to temperature changes
Stability to light	stable
Reaction to chemicals	attacked by acids

Spinel

Mineral class	oxides
Group	spinel
Mineral species	spinel
Crystal system	cubic
Chemical composition	$MgAl_2O_4$
Variety	chlorospinel, ceylonite or pleonaste, asteriated spinel (star spinel), color change spinel and noble spinel
Trade names	rubycela, ceylonite, pleonaste, flame spinel, asteriated spinel (star spinel), color change spinel, almandine spinel and noble spinel; erroneous: balas ruby, spinel ruby, spinel sapphire and sapphirine
Color	red, pink, orange, blue, violet, purple, colorless, yellow, green, brown and black
Transparency	from transparent to opaque
Luster	vitreous to subadamantine
Optical phenomena	asterism (rare), color change
Refractive Indices	1.718 (+ .017, - .008)
Optic character	SR
Birefringence	none
Dispersion	.020
Pleochroism	none
Flourescence	red, orange and pink - inert to weak red to red-orange (SW); weak to strong, red and orange; "cobalt" blue (rare) - strong: intense whitish green (SW); strong red (LW); near colorless and light green (both rare) - inert to moderate orange to orange-red (LW); all other colors - vitually inert
Absorption spectra	red - sharp lines at 685.5 and 684 nm, a weak band at 656 and strong absorption at about 595 to 490 nm; pink and vivid red stones may show five bright flourescent lines in the red due to chromium; blue - strong band around 460 nm; may also present bands around 430-435, 480, 550, 565-575, 590 and 625 nm; violet and purple - may show the same spectrum as blue stones, but weakly
Specific gravity	3.60 (+.10. - .03); black - near 4.0; blue and green samples varying into gahnospinel
Fracture	conchoidal with a vitreous luster
Cleavage	poorly developed; not seen in gem quality material
Identifying characteristics	minute octahedral crystals arranged either singly or in "fingerprint" patterns; apatite, dolomite
Possible treatments	unknown
Possibly mistaken with	synthetic spinels (blue, red, colorless and light green), light green grossular, pyrope, idocrase, synthetic and natural corundum, taaffeite, chrysoberyl and kyanite
Hardness	8

STABILITY

Reaction to heat	light colored stones may fade under intense heat
Stability to light	stable
Reaction to chemicals	none



Spodumene

Mineral class	silicates
Group	pyroxene
Mineral species	spodumene
Crystal system	monoclinic
Chemical composition	$LiAlSi_2O_6$
Variety	kunzite, hiddenite and triphane
Trade names	kunzite, hiddenite and triphane; misnomers: lithium emerald (improper designation for light green or irradiated green spodumene)
Color	pink to bluish purple, green, yellow, colorless, blue (very rare); colored varieties typically light in tone
Transparency	transparent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.660 - 1.676 (±.005), hiddenite - usually 1.662 - 1.676
Optic character	biaxial positive, DR
Birefringence	.014 to .016, hiddenite usually .014
Dispersion	.017
Pleochroism	• kunzite - moderate to strong, pink to light purple and colorless • hiddenite - moderate, bluish green and yellowish green
Flourescence	• kunzite - moderate to strong, from pink to orange (LW), weaker (SW) • yellowish green samples - weak orange yellow (LW), weaker (SW) • hiddenite - inert
Absorption spectra	• kunzite - not diagnostic • yellow-green - lines near 433 nm and 438 nm • hiddenite - lines at 646, 669, 686, 690 nm and broad absorption near 620 nm
Specific gravity	3.18 (±.03)
Fracture	unever to splintery with a vitreous luster
Cleavage	perfect in two directions
Identifying characteristics	liquid inclusions
Possible treatments	irradiation
Possibly mistaken with	tourmaline, peridot, beryl, sillimanite, euclase, phenakite and kornerupine
Hardness	6.5 - 7

STABILITY

Reaction to heat	sensitive
Stability to light	kunzite fades; irradiated green fades rapidly
Reaction to chemicals	very slowly attacked by concentrated hydrofluoric acid

Tanzanite

Mineral class	silicates
Group	epidote
Mineral species	zoisite
Crystal system	orthorhombic
Chemical composition	$Ca_2Al_3(SiO_4)_3(OH)$
Variety	tanzanite, thulite
Trade names	tanzanite, zoisite, thulite, cat's-eye zoisite, rosaline, unionite; misnomers: Meru sapphire
Color	blue to violet to bluish purple, brown, yellowish green, pink
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	chatoyancy (rare)
Refractive Indices	1.691 - 1.700 (± .005)
Optic character	biaxial positive, DR; AGG
Birefringence	.008 a .013
Dispersion	.021
Pleochroism	tanzanite - strong blue, purplish red and greenish yellow; brown - strong green, purple and light blue; yellowish green - strong dark blue, green-yellow and purple
Flourescence	usually inert
Absorption spectra	595, 528, 455 nm
Specific gravity	3.35 (+ .1. - .25)
Fracture	conchoidal to irregular, with vitreous to dull luster
Cleavage	perfect in one direction
Identifying characteristics	fractures, liquid feathers, ruby and hornblende
Possible treatments	heating (produces tanzanite colors in certain crystals with initially brownish colors)
Possibly mistaken with	zoisite from - sapphire, spinel, benitoite, tourmaline, dioptase, epidote, enstatite, transparent idocrase, axinite, diopside, peridot, iolite, kyanite. thulite from - rhodonite and hydrogrossular garnet
Hardness	6 - 7

STABILITY

Reaction to heat	fuses under jeweler's torch; sudden temperature change (heating or cooling) may cause cracking
Stability to light	stable
Reaction to chemicals	attacked by hydrochloric acid and hydrofluoric

Tiger´s-Eye

Mineral class	silicates
Mineral species	quartz
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Variety	tiger's-eye
Trade names	tiger's-eye, hawk's-eye and zebra tiger's-eye; misnomers: cat's-eye, crocidolite and petrified wood
Color	brownish yellow to brown to reddish brown
Transparency	semitranslucent to opaque
Luster	vitreous
Optical phenomena	chatoyancy
Refractive Indices	1.544 – 1.553
Optic character	AGG, if not opaque
Birefringence	.009 (often undetectable)
Pleochroism	none
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	2.64 to 2.71
Fracture	splintery to conchoidal, with vitreous to silky luster
Cleavage	none
Identifying characteristics	fibrous structure (causes the chatoyancy); the wavy fibrous structure of tiger's-eye and hawk's-eye is usually distinctive
Possible treatments	heat treatment, dyeing and bleaching
Possibly mistaken with	chalcedony and labradorite
Hardness	7

STABILITY

Reaction to heat	may fracture or break when subjected to abrupt temperaute changes
Stability to light	stable
Reaction to chemicals	soluble in hydrofluoric acid and ammonium fluoride; very slightly soluble in alkalies

Topaz

Mineral class	silicates
Mineral species	topaz
Crystal system	orthorhombic
Chemical composition	$Al_2(F,OH)_2SiO_4$
Variety	imperial topaz and cat's-eye topaz
Trade names	• imperial topaz - pink, orangish pink, yellow, orangish to orangish red; • cherry topaz - medium orangish red • blue topaz
Color	colorless, yellow, orangish, brown, pink to red to purplish-red; blue: light to dark, light green
Transparency	transparent
Luster	vitreous
Optical phenomena	chatoyancy (rare, sometimes in blue and orange-yellow gems)
Refractive Indices	1.619 - 1.627 (± .010)
Optic character	biaxial positive, DR
Birefringence	.008 to .010
Dispersion	.014
Pleochroism	• yellow samples - weak to moderate, brownish yellow, yellow and orange-yellow • brown samples - weak to moderate, brown-yellow and brown • red and pink samples - weak to moderate, light red and orangish red to yellow • green samples - weak to moderate, blue-green and light green • blue samples - weak to moderate, different blue tones
Flourescence	• yellow to brown and pink to red samples - weak to moderate, orangish yellow (LW, generally weaker SW) • some pink samples - moderate, greenish white (SW) • blue and colorless samples - inert to weak, yellow or green (LW, generally weaker SW)

Absorption spectra	not diagnostic
Specific gravity	3.53 (± .04)
Fracture	conchoidal, with vitreous luster
Cleavage	perfect in one direction
Identifying characteristics	inclusions containing two or more nonmiscible liquids, two-phase or three-phase inclusions, hematite, quartz and fractures
Possible treatments	• thermal treatment - change some of the yellow, orangish and brown samples to pink or red • irradiation - turns some colorless samples to brown or brownish green - the first stage in producing treated blue topaz
Possibly mistaken with	tourmaline, andalusite, barite, beryl, quartz, danburite, apatite, synthetic spinel, chrysoberyl and kunzite
Hardness	8

STABILITY

Reaction to heat	rapid heating or cooling will cause internal fractures; strong heat may alter or destroy color
Stability to light	some brown stones fade under intense light
Reaction to chemicals	attacked very slightly by acids

Tourmalinated Quartz

Mineral class	silicates
Mineral species	quartz
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Variety	tourmalinated quartz
Trade names	fleches d'amour, tourmalinated quartz and sagenitic quartz (general term referring to transparent quartz containing eye-visible needle-like inclusions)
Color	usually colorless with needle-like inclusions of dark green or black tourmaline
Transparency	transparent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.544 - 1.553
Optic character	uniaxial positive, DR
Birefringence	.009
Dispersion	.013
Pleochroism	none
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	2.66 (+ .03, - .02)
Fracture	conchoidal to irregular, with vitreous luster
Cleavage	none
Identifying characteristics	needle-like tourmaline inclusions, liquid inclusions, negative crystals, two-phase or three-phase inclusions and fractures
Possible treatments	unknown
Possibly mistaken with	none
Hardness	7

STABILITY

Reaction to heat	may fracture when subjected to abrupt temperature changes
Stability to light	stable
Reaction to chemicals	soluble in hydrofluoric acid and ammonium fluoride; very slightly soluble in alkalies

Turquoise

Mineral class	phosphates
Group	turquoise
Mineral species	turquoise
Crystal system	trigonal
Chemical composition	$CuAl_6(PO_4)_4(OH)_8 5H_2O$
Trade names	turquoise, persian turquoise, american turquoise, mexican turquoise, egyptian turquoise and spiderweb turquoise
Color	medium to light blue, greenish blue to green, often mottled, may show dark splotches or veins of matrix
Transparency	semitranslucent to opaque
Luster	waxy to vitreous
Optical phenomena	none
Refractive Indices	1.610 - 1.650 usually 1,61 spot reading
Optic character	AGG; DR
Birefringence	usually undetected
Dispersion	none
Pleochroism	none
Flourescence	inert to weak, greenish yellow (LW), inert (SW)
Absorption spectra	ocasionally show two medium to weak bands at 420 and 432 nm (the latter is stronger); may also have a weak band at 460 nm
Specific gravity	2.76 (+ .14, - .36)
Fracture	conchoidal or granular, depending on porosity; waxy to dull luster
Cleavage	none
Identifying characteristics	often has matrix
Possible treatments	plastic impregnation, sometimes with a colorant added (produces medium blue from nearly white, very porous material; also improves durability); wax impregnation (seals the pores and deepens the color of porous, light colored material); dyeing with liquid black shoe polish (imitates matrix); backing thin pieces with an epoxy (adds thickness, strength and weight to pieces too thin to be cut otherwise); filling cavities with a metal-loaded epoxy, usually a yellowish pyrite (fills cavities and imitates pyrite inclusions); surface coating with lacquer, epoxy, etc (to add color or to seal underlying dye or paint)
Possibly mistaken with	variscite, synthetic turquoise, dyed howlite, serpentine, amazonite, glass, plastic and pectolite
Hardness	5 - 6

STABILITY

Reaction to heat	under strong heat (torch) may explode; lose color
Stability to light	stable
Reaction to chemicals	dissolves slowly in hydrochloric acid; may be discolored by specific gravity liquids, perspiration and cosmetics

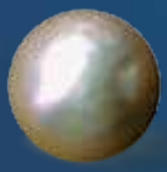
Zircon

Mineral class	silicates
Mineral species	zircon
Crystal system	tetragonal
Chemical composition	$ZrSiO_4$
Variety	depending on the structural breakdown; zircon is classified as high, medium or low type, also called alpha, beta or gamma.
Trade names	• high and medium types - colorless, blue, yellow to green-yellow, brownish green, orangish to brown and orangish red to brownish • low type - brownish green to yellowish with a cloudy texture, rarely brown or orangish • jacinth - reddish brown • starlite - blue • jargon - light yellow to colorless stones from Sri Lanka • beccarite - green • sparklite - colorless • misnomers: Siam aquamarine, Matara diamond, Sri Lanka diamond
Color	colorless, blue, yellow, green, brown, orangish, red and ocasionally purple
Transparency	transparent
Luster	vitreous to adamantine
Optical phenomena	chatoyancy (rare)
Refractive Indices	high type - 1.925 - 1.984 (± .040); medium type - 1.875 - 1.905 (± .030); low type - 1.810 - 1.815 (± .030), very rare under 1.80
Optic character	uniaxial positive, DR; some of the low type samples are virtually SR
Birefringence	.000 to .059; low type: none or very low birefringence; high type: high birefringence
Dispersion	.038
Pleochroism	• blue samples - strong blue and brownish yellow to colorless • green samples - very weak, green and green-yellow • orangish and brown samples - weak to moderate, purplish brown and brownish yellow • red samples - moderate, reddish purple and purplish brown
Flourescence	• red to orangish-red samples - inert to strong, yellow to orangish (SW) • green samples - generally inert • yellow to orangish-yellow samples - inert to moderate, yellow to orangish (SW and LW) • blue samples - inert to moderate, light blue (LW) • brown samples - inert to very weak - red (SW)

Absorption spectra	• some green stones may show as many as forty or more absorption lines and bands • some red and brown stones show none • some blue and colorless stones show a line at 653.5 nm • low type often show only a broad, vague line in the 653.5 nm
Specific gravity	varies from 3.90 to 4.73 (gradual increase from low to high type)
Fracture	conchoidal, with vitreous to subadamantine luster
Cleavage	none
Identifying characteristics	some blue and many colorless stones - minute, white cottony inclusions; low type green - usually show very strong repeated twinning or zoning that may impart a milky appearance at some angles of illumination; skeletal, angular inclusions are commom
Possible treatments	heat treatment - change color from brown to red, orange, yellow, colorless or blue
Possibly mistaken with	synthetic rutile, diamond, strontium titanate, CZ, GGG, YAG, spessartine, andradite, sphene and sphalerite
Hardness	6 (low type) - 7.5 (high type)

STABILITY

Reaction to heat	high and some medium types may change to colorless, blue, yellow or red
Stability to light	some heat-treated stones may revert to their original color
Reaction to chemicals	none



ORGANIC GEMS SPECIFICATIONS

Amber

Mineral class	an amorphous organic material consisting of fossilized resin of prehistoric trees (usual age: 10 - 100 million years)
Crystal system	none, amorphous
Chemical composition	$C_{10}H_{16}O$, variable
Variety	sea amber, pit amber
Trade names	block amber, baltic amber, sea amber, pit amber, clear amber, fatty amber, cloudy amber, foamy amber, bone amber, silician amber (simetite), burmese amber, roumanian amber, chinese amber, pressed amber (amberoid), dominican amber, Bernstein, gedanite, chemawinite or cedarite, sun-spangled or stress spangled amber, bastard amber, blue amber, massive amber
Color	ligh yellow to dark brown, orange, red, white; occasionally greenish or bluish, due to strong fluorescence
Transparency	transparent to opaque
Luster	resineous to vitreous
Optical phenomena	none
Refractive Indices	1.540 (+ 0.005, -0.001)
Optic character	SR; strong ADR and strain colors are common
Birefringence	none
Pleochroism	none
Flourescence	inert to strong yellowish green to orangish yellow, white, bluish, white, or blue (LW); weaker (SW)
Absorption spectrum	not diagnostic
Specific gravity	1.08 (+ 0.02, - 0.08); air bubbles will lower SG
Fracture	conchoidal
Cleavage	none
Identifying characteristics	gas bubbles, flow lines, insects; other organic and inorganic inclusions
Possible treatments	heating - produces dark amber from light colored amber; heating in oil - clarifies cloudy amber; dyeing - adds a different or darker color to light material; heating, sometimes with oil - produces disk-like fractures creating sun spangled amber
Possibly mistaken with	chalcedony, plastic, citrine quartz, copal, reconstructed amber
Hardness	2 - 2,5

STABILITY

Reaction to heat	burns at low temperatures, giving off resinous odor
Stability to light	may darken with age
Reaction to chemicals	attacked by acids, strong solvents and chemicals, such as isopropyl (rubbing) alcohol.

Ammonite

Nature of Material	a fossilized, mineralized ammonite shell (resembles a nautilus shell) or casts of the interior of the shell
Chemical composition	variable, often aragonite, calcite, pyrite, silica and others
Trade names	ammonite, ammolite, korite, aapaok and calcentine (promotinal name for iridescent canadian material)
Color	orange, gray to brown, sometimes iridescent
Transparency	opaque
Luster	vitreous
Optical phenomena	iridescence
Refractive Indices	usually 1.52 – 1.68; varies with mineral content
Optic character	AGG
Birefringence	usually 0.155; varies with mineral content
Pleochroism	none
Flourescence	variable
Absorption spectrum	not diagnostic
Specific gravity	usually about 2.70; varies with mineral content
Fracture	uneven to granular
Cleavage	usually none visible
Identifying characteristics	spiral stucture of well preserved specimens; distinctive iridescent patterns, often mosaic like
Possible treatments	lacquer coating
Possibly mistaken with	none, its appearence is unique
Hardness	variable

STABILITY

Reaction to heat	breacks down and loses iridescence
Stability to light	stable
Reaction to chemicals	attacked by acids

Conch Pearl

Nature of Material	organic
Chemical composition	$CaCO_3$ plus organic matter and water
Variety	Strombus gigas pearl
Trade names	conch pearl, pink pearl
Color	white (rare), generally "off-white", light to dark pink, brown, orange, salmon, cream to yellow, yellowish brown
Transparency	translucent to opaque
Luster	vitreous
Optical phenomena	none
Refractive Indices	1,530 – 1,685
Optic character	AGG
Birefringence	.155
Pleochroism	none
Flourescence	weak, blue to yellow-white
Absorption spectrum	not diagnostic
Specific gravity	brown – 2,18 - 2,77 and pink – 2,84 – 2,87
Fracture	uneven, with dull luster
Cleavage	none
Identifying characteristics	flame structure, porcelain surface appearance
Possible treatments	none known
Possibly mistaken with	shell, coral
Hardness	brown, 4 - 5 and pink, 5 - 6

STABILITY

Reaction to heat	may crack or loses color
Stability to light	loses color at sunlight
Reaction to chemicals	attacked by acids, mainly hydrochloric acid, effervesces

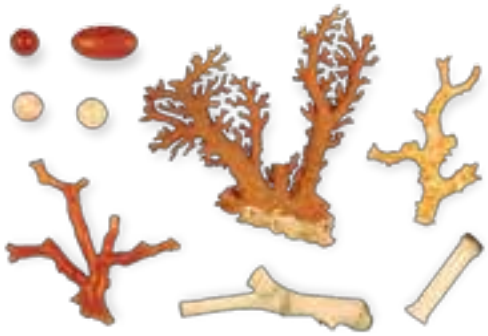
Copal

Nature of Material	amorphous organic material consisting of fossilized resin, more recent in origin than amber
Crystal system	amorphous
Chemical composition	variable
Variety	copal
Trade names	Copal and Kauri resin; wrong: amber
Color	yellow, orange, brown
Transparency	transparent to translucent
Luster	resinous to vitreous
Optical phenomena	none
Refractive Indices	1.540 (- 0.010)
Optic character	SR; strong ADR reaction common
Birefringence	none
Dispersion	none
Pleochroism	none
Flourescence	inet to weak bluish white (LW); inert to strong bluish white (SW); whiter reaction than amber (especially SW)
Absorption spectrum	not diagnostic
Specific gravity	1.06 (+ 0.04, - 0.03)
Fracture	conchoidal to uneven
Cleavage	none
Identifying characteristics	surface crazing common
Possible treatments	any treatment used for amber can be used for copal
Possibly mistaken with	amber
Hardness	2

STABILITY

Reaction to heat	burns
Stability to light	darkens with age
Reaction to chemicals	ether causes swelling and softening to a sticky mass, dulls the surface being tested; made sticky by contact with turpentine and acetone

Coral (Calcareous)



Nature of Materiall	an organic material; it is the remains of a colony of tiny marine animals
Crystal system	trigonal
Chemical composition	mainly $CaCO_3$ (in the form of calcite)
Trade names	angel's skin, white, pink, red, ox-blood coral, japanese coral, italian coral, sicilian coral, algerian coral and coral
Color	light pink to dark red, orange, white and cream colors; ocasionally blue or purple
Transparency	semitranslucent to opaque
Luster	waxy to vitreous
Optical phenomena	none
Refractive Indices	1.486 - 1.658
Optic character	AGG, if not opaque
Birefringence	0.172
Pleochroism	none
Flourescence	white - inert to weak to strong bluish white (LW and SW); light and dark orange, red and pink - inert to orange to pinkish orange (LW and SW); dark red - inert to dull red to puplish red (LW and SW)
Absorption spectrum	not diagnostic
Specific gravity	2.65 (± 0.05)
Fracture	splintery to uneven
Cleavage	none
Identifying characteristics	cavities from polyps, wavy fibrous structure, high spot birefringence
Possible treatments	dyeing - deepens or changes color; impregnation with epoxy or glue-like materials, fills and hides surface cavities in low quality material
Possibly mistaken with	calcite, marble, onyx, shell, chalcedony, calcareous concretions, coral imitation (Gilson), howlite and ivory
Hardness	3.5 - 4

STABILITY

Reaction to heat	blackens in the flame of a jeweler's torch
Stability to light	stable
Reaction to chemicals	attacked by acids, effervesces to hydrochloric acid

Coral (Conchiolin)

Nature of Material	it is the remains of a colony of tiny marine animals
Crystal system	trigonal
Chemical composition	$C_{32}H_{48}N_2O_{11}$
Variety	black coral, golden coral and blue coral
Trade names	black coral, golden coral, blue coral, royal coral, akabar, giogetto
Color	black, dark brown, yellow (golden)
Transparency	semitranslucent to opaque
Luster	waxy to vitreous
Optical phenomena	distinctive surface sheen in golden varieties
Refractive Indices	1.560 - 1.570 (± 0.010)
Optic character	AGG, if not opaque
Birefringence	none
Dispersion	none
Pleochroism	none
Flourescence	inert
Absorption spectrum	not diagnostic
Specific gravity	1,35 (+ .77, - 0.05)
Fracture	conchoidal to uneven
Cleavage	none
Identifying characteristics	concentric circular growth ("tree-ring") structure, white crescents in the cross sections of the branches
Possible treatments	bleaching (soaking in 30% solution of hydrogen peroxide) - produces a golden color from black coral
Possibly mistaken with	plastics, jet, chalcedony, calcareous concretions
Hardness	3

STABILITY

Reaction to heat	burns easily, with a protein odor (burnt hair)
Stability to light	stable
Reaction to chemicals	easily attacked

Cultured Pearl

Nature of Material	grown in certain saltwater and freshwater mollusks where man has inserted a nucleus (usually a shell bead or a piece of mantle tissue)
Crystal system	orthorhombic (aragonite), trigonal (calcite)
Chemical composition	$CaCO_3$
Variety	cultured saltwater pearl and cultured freshwater pearl
Trade names	cultured pearl, cultured blister pearl, 3/4 blister cultured pearl, assembled cultured mabe pearl, Biwa cultured pearl, chinese cultured pearl, South Seas cultured pearl, akoya cultured pearl keshi
Color	virtually any bodycolor, but usually white or light yellow (designated cream), gray, green, blue and black
Transparency	translucent to opaque
Luster	nearly dull to almost metallic
Optical phenomena	orient - an iridescent effect, usualy faint
Refractive Indices	1.530-1.685
Optic character	AGG, if not opaque
Birefringence	0.155
Dispersion	none
Pleochroism	none
Flourescence	inert to strong light blue, yellow, green or pink (LW and SW); natural color black - weak to moderate red to orangish red (LW)
Absorption spectrum	varies widely, not diagnostic
Specific gravity	saltwater - 2.70 to 2.78 (higher than most natural pearls); freshwater - lower than most natural freshwater pearls
Fracture	uneven
Cleavage	none
Identifying characteristics	gritty to cutting edges of teeth (most imitations smooth); internal detail as reveled in X-radiograph (distinguishes from natural); sometimes visual clues from examination of drill hole or striped appearance from candling
Possible treatments	bleaching - bleaches dark spots of conchiolin that show through the nacre; dyeing - to alter the bodycolor or hide colored blemishes; irradiation - to produce "black" pearls, also blue or gray from bleached pearls
Possibly mistaken with	natural pearl; glass, plastic and acrylic imitations
Hardness	2.5 - 4

STABILITY

Reaction to heat	excessive heat, such as open flame, may cause pearls to burn, turn brown, split, or crack. Prolonged moderate heat (even from light bulb in display case) can cause dehydratation which can make nacre crack
Stability to light	stable
Reaction to chemicals	attacked by all acids; acid perspiration, perfume or hairspray also attacks nacre

Horn

Nature of Material	organic
Chemical composition	the horn of an animal suck as a stag, a rhinoceros or a bull; with a fribrous structure and a variable chemical composion (basically a protein material)
Variety	by animal
Trade names	by animal: rhinoceros, bull
Color	yellow to brown, almost black
Transparency	semitransparent to opaque
Luster	resinous to vitreous
Optical phenomena	none
Refractive Indices	1.560
Optic character	SR; AGG
Birefringence	none
Pleochroism	none
Flourescence	variable
Absorption spectrum	not diagnostic
Specific gravity	1.70 to 1.85
Fracture	uneven to splintery
Cleavage	none
Identifying characteristics	undulating fibrous structure
Possible treatments	none known
Possibly mistaken with	horn of other materials
Hardness	2.5

STABILITY

Reaction to heat	may dry and crack with low heat, burns easily
Stability to light	may gradually bleach
Reaction to chemicals	attacked by chemical agents

Ivory (Elephant)

Nature of Material	most ivory is from elephant tusks, although walrus tusks and the tusks of other animals are also used as ivory
Crystal system	amorphous
Chemical composition	$(Ca_3OH)_2(PO_4)_6Ca_4$ and 35% of organic material
Variety	green, cape, hard
Trade names	green ivory (Tanzania), Cape ivory, hard ivory (Angola) and ivory
Color	white to light yellow
Transparency	translucent to opaque
Luster	greasy to dull
Optical phenomena	none
Refractive Indices	1.535 - 1.540 usually 1.540
Optic character	AGG
Birefringence	none
Dispersion	none
Pleochroism	none
Flourescence	weak to strong bluish white or violet-blue (LW and SW, LW stronger)
Absorption spectrum	not diagnostic
Specific gravity	1.70 to 2.00
Fracture	splintery
Cleavage	none
Identifying characteristics	wavy structure lines
Possible treatments	dyeing - to create the appearance of antique ivory; bleaching - lightens or removes staining
Possibly mistaken with	bone, white coral, plastic, chalcedony, vegetable ivory, hippopotamus ivory, other animals ivories
Hardness	2.25 - 2.75

STABILITY

Reaction to heat	causes shrinkage and discoloration
Stability to light	yellow with age
Reaction to chemicals	attacked; softened by nitric and phosphoric acid

Jet

Nature of Material	coal formed by fossil wooden with 180 million years found in the deep of the ocean
Crystal system	amorphous
Chemical composition	primary composition: carbon, with some hydrogen and oxygen (a hydrocarbon)
Variety	lignite
Trade names	whitby jet; misnomers: black amber and dark agate
Color	very dark brown to black
Transparency	semitranslucent to opaque
Luster	waxy to vitreous
Optical phenomena	none
Refractive Indices	1,660 (± 0.020)
Optic character	SR
Birefringence	none
Dispersion	none
Pleochroism	none
Flourescence	inert
Absorption spectrum	not diagnostic
Specific gravity	1.32 (± 0.02)
Fracture	conchoidal, with blackish to greasy luster
Cleavage	none
Identifying characteristics	brown veins and fracture
Possible treatments	none known
Possibly mistaken with	plastic, black coral, chalcedony and other black opaque minerals and vulcanite (hard rubber)
Hardness	2.5 - 4

STABILITY

Reaction to heat	burns easily with a coal or oily odor
Stability to light	stable
Reaction to chemicals	acids may dull the surface

Pearl

Nature of Material	formed in the bodies of certain saltwater and freshwater mollusks around an irritant or parasite, or due to an abnormal physiological condition, and without human intervention of any kind; they are made up mostly of fine crystalline layers called nacre
Crystal system	orthorhombic (aragonite), trigonal (calcite)
Chemical composition	$CaCO_3$ (most of it as aragonite, the rest calcite); pearls also contain an organic binder called conchiolin and small amounts of water
Variety	by the bodycolor and overtone, shape, and place of origin
Trade names	pearl with the following prefixes: pink, white, cream rosé, black, colored, oriental, natural, fine, maiden, blister, dust, wild, seed, baroque, freshwater, saltwater, Ceylon or Madras, Bombay, Tahiti, South Seas, Venezuela, Australia and La Paz, among others
Color	virtually any bodycolor, but usually white or light yellow (designated cream), gray, black, green, pink or blue
Transparency	translucent to opaque
Luster	nearly dull to almost metallic
Optical phenomena	orient - iridescent effect, usually faint
Refractive Indices	1.530 - 1.685
Optic character	AGG, if not opaque
Birefringence	0.155
Dispersion	none
Pleochroism	none
Flourescence	inert to strong light blue, yellow, green, or pink (LW and SW); natural color black pearls - weak to moderate red to orangish red or brownish red (LW); La Paz strong red (LW)
Absorption spectrum	not diagnostic
Specific gravity	saltwater - 2.61 to 2.85; freshwater - 2.66 to 2.78; few are over 2.74
Fracture	uneven
Cleavage	none
Identifying characteristics	gritty to cutting edges of teeth (most imitations smooth); internal detail as revealed in X-radiograph (distinguishes from cultured pearl)
Possible treatments	bleaching - bleaches cark spots of conchiolin that show through the nacre; dyeing - either to alter the body to a uniform black, or lightly dyed to reduce visibility of colored blemishes
Possibly mistaken with	cultured pearl, glass imitation pearl, plastic imitation pearl
Hardness	2.5 - 4.5

STABILITY

Reaction to heat	excessive heat, such as open flame, may cause pearls to burn, turn brown, split or crack. Prolonged moderate heat (even from light bulbs in display cases) can cause dehydration which can make nacre crack
Stability to light	stable
Reaction to chemicals	attacked by all acids; acid perspiration, perfume or hairspray also attacks nacre

Shell

Nature of Material	shell is an organically formed material that was the covering of a saltwater or freshwater animal; the ones which have in the internal face a pearly luster, have more gemological value
Crystal system	miscellaneous
Chemical composition	$CaCO_3$ plus some organic matter and water
Variety	helmut shell, conch shell, operculum, abalone shell
Trade names	shell, mother-of-pearl, operculum, helmut shell, conch shell and abalone shell; wrong: chinese cat's-eye
Color	virtually any color, but commonly white, gray, brown, yellow, orange and pink; often with a layered or patterned coloring
Transparency	translucent to opaque
Luster	greasy or pearly
Optical phenomena	orient (iridescense effect)
Refractive Indices	1.530 - 1.685
Optic character	AGG
Birefringence	0.155
Dispersion	none
Pleochroism	none
Flourescence	variable, by the shell
Absorption spectrum	not diagnostic
Specific gravity	2.86 (+ 0.3. - 0.16)
Fracture	uneven to splintery
Cleavage	none
Identifying characteristics	helmut shell cameo - straight irregular fibrous stucture, concave back; operculum - eye-like marking on front, spiral growth on back; conch shell - flame-like stucture
Possible treatments	dyeing - to produce a variety of colors
Possibly mistaken with	coral, chalcedony, ivory, calcareous concretions, plastic
Hardness	3.5

STABILITY

Reaction to heat	blackens in the flame of a jeweler's torch
Stability to light	conch shell gradually fades in sunlight
Reaction to chemicals	attacked by acids, effervesces with hydrochloric acid

Tortoise-Shell

Nature of Material	organic
Chemical composition	variable chemical composition
Trade names	tortoise-shell
Color	brown and mottled yellow, occasionally black and white
Transparency	semitransparent to translucent
Luster	waxy to resinous
Optical phenomena	none
Refractive Indices	1.550 (-0.010)
Optic character	SR
Birefringence	none
Pleochroism	none
Flourescence	yellow or colorless parts – bluish white (LW e SW)
Absorption spectrum	not diagnostic
Specific gravity	1.29 (+0.06, -0.03)
Fracture	uneven to shattered, with dull luster
Cleavage	none
Identifying characteristics	mottled coloration, numerous spherical particles seen with magnification, readly sectile, protein (burnt hair) odor to hot point
Possible treatments	dyeing of many colors, lamination
Possibly mistaken with	plastic, horn
Hardness	2.5

STABILITY

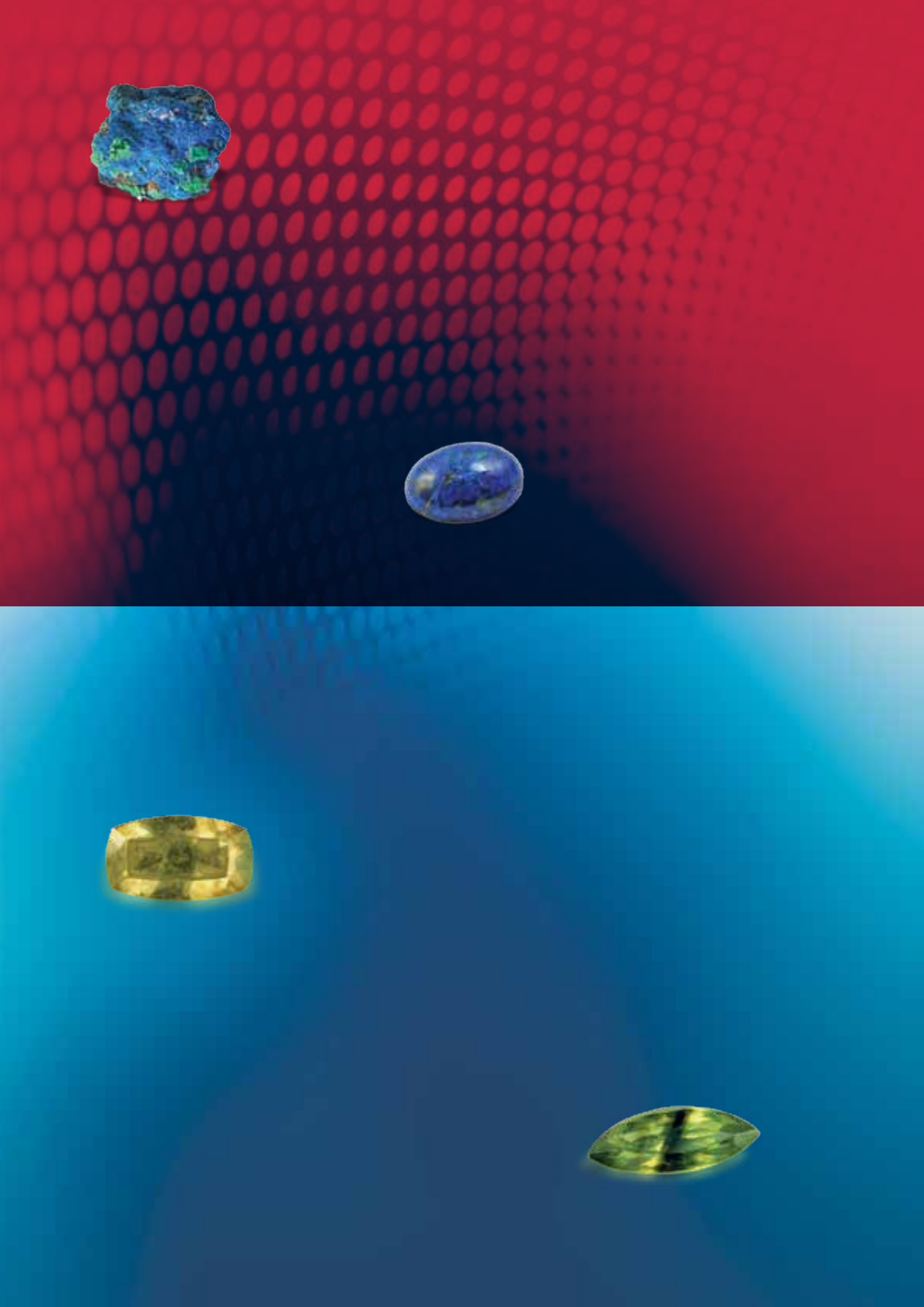
Reaction to heat	softens at boiling water temperature; high heat darkens the material; burns with a protein odor (burnt hair)
Stability to light	darken with age
Reaction to chemicals	attacked by nitric acid, but not hydrochloric acid

Vegetable Ivory

Nature of Material	organic
Chemical composition	constituted almost entirely of cellulose, $C_6H_{10}O_5$ (product made of a fruit seed or nut of the Phytelephas macrocarpa, native of the Amazon region)
Trade names	vegetal ivory, jarina, corozo, tágua, pullipunta, homero
Color	white, beige
Transparency	semitranslucent to opaque
Luster	greasy to dull
Optical phenomena	none
Refractive Indices	1.54
Optic character	SR
Birefringence	none
Dispersion	none
Pleochroism	none
Flourescence	weak, bluish white or purplish blue (LW and SW)
Absorption spectrum	not diagnostic
Specific gravity	1.40 – 1.43
Fracture	uneven
Cleavage	none
Identifying characteristics	texture with aspect of micron canals in transversal section and thick and parallel rods forming drawings that look like torpedoes, in longitudinal section
Possible treatments	dyeing with many colors, chemical precipitation
Possibly mistaken with	animal ivory, plastic
Hardness	2.5

STABILITY

Reaction to heat	stable, at low temperatures
Stability to light	stable
Reaction to chemicals	attacked by concentrated sulphuric acid, becomes pink



UNUSUAL GEMS SPECIFICATIONS

Actinolite

Mineral class	silicates
Group	amphibole
Mineral species	actinolite
Crystal system	monoclinic
Chemical composition	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$
Variety	cat's-eye actinolite
Trade names	actinolite and cat's-eye actinolite; misnomers: cat's-eye jade
Color	light to dark green, yellowish green and black
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	chatoyancy
Refractive Indices	1.614 – 1.641 (+ .014); spot reading generally 1.63
Optic character	AGG; DR, biaxial negative
Birefringence	.022 to .027
Pleochroism	moderate, yellow and dark green
Flourescence	inert
Absorption spectra	faint line at 503 nm
Specific gravity	3,00 (+ .10 - .05)
Fracture	irregular, with vitreous luster, sometimes dull
Cleavage	perfect in two directions (obscured in aggregates)
Identifying characteristics	cat's-eye - parallel fibrous structure
Possible treatments	unknown
Possibly mistaken with	cat's-eye tourmaline and cat's-eye apatite
Hardness	5 – 6

STABILITY

Reaction to heat	not sensitive to low heat, melts at 1.293°C
Stability to light	stable
Reaction to chemicals	not attacked by acids

Aragonite

Mineral class	carbonates
Mineral species	aragonite
Crystal system	orthorhombic
Chemical composition	$CaCO_3$
Trade names	aragonite and by color
Color	colorless, white, gray, yellow, red, green, green-blue, brown and violet
Transparency	transparent to opaque
Luster	vitreous to resinous
Optical phenomena	none
Refractive Indices	1.530 – 1.685
Optic character	biaxial negative, DR; AGG
Birefringence	.155
Dispersion	.007 a .012
Pleochroism	none
Flourescence	inert to moderate, various colors (LW e SW), may phosphoresce green (LW)
Absorption spectra	not diagnostic
Specific gravity	2.94 (± .01) may be higher due to lead impurities
Fracture	subconchoidal to splintery, with vitreous to silky luster
Cleavage	distinct in one diretion
Identifying characteristics	none
Possible treatments	unknown
Possibly mistaken with	calcite, chalcedony, coral and alabaster
Hardness	3.5 – 4

STABILITY:

Reaction to heat	converts to calcite at medium temperature, decreptating loudly without fusing
Stability to light	stable
Reaction to chemicals	effervesces to hydrochloric acid, attacked by other acids

Axinite

Mineral class	silicates
Group	axinite
Mineral species	axinite
Crystal system	triclinic
Chemical composition	$(Ca,Fe,Mn,Mg)_3Al_2BSi_4O_{15}(OH)$
Trade names	axinite
Color	brown, purplish brown, brownish yellow, violet and blue
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.678 – 1.688 (± .005)
Optic character	biaxial negative, DR
Birefringence	.010 to .012
Dispersion	.011
Pleochroism	strong, violet to purple, light yellow and brown-red
Flourescence	generally inert, yellow stones may flouresce red (SW)
Absorption spectra	lines at 412, 466, 492 and 512 nm
Specific gravity	3.29 (+.07, -.03)
Fracture	conchoidal to irregular, with vitreous luster
Cleavage	distinct in one direction
Identifying characteristics	strong pleochroism, color zoning, fibrous inclusions
Possible treatments	unknown
Possibly mistaken with	brown stones may be confused with smoky quartz, enstatite, kornerupine and zoisite; brownish yellow may be confused with chrysoberyl, hessonite garnet, topaz and tourmaline
Hardness	6.5 - 7

STABILITY

Reaction to heat	somewhat sensitive
Stability to light	stable
Reaction to chemicals	not attacked

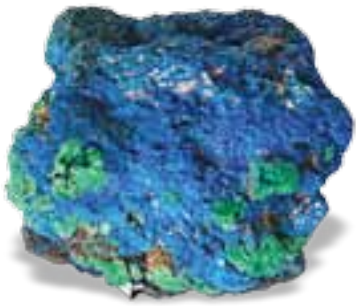
Azurite

Mineral class	carbonates
Mineral species	azurite
Crystal system	monoclinic
Chemical composition	$Cu_3(CO_3)_2(OH)_2$
Trade names	chessylite, blue copper carbonate, azure stone and chessy copper; misnomers: blue malachite, copper lapis
Color	dark blue to purplish blue
Transparency	usually semitranslucent to opaque, rarely transparent
Luster	vitreous to waxy
Optical phenomena	none
Refractive Indices	1.730 – 1.840 (± .010)
Optic character	biaxial positive, DR; AGG
Birefringence	.106
Dispersion	none
Pleochroism	moderate to strong – light to dark blue
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	3.80 (+.09, -.50)
Fracture	conchoidal to irregular, with greasy to dull luster
Cleavage	two directions, perfect to distinct, but usually obscured in aggregate material
Identifying characteristics	light blue streak, botryoidal structure common
Possible treatments	Impregnation wth paraffin or epoxy resin
Possibly mistaken with	lapis lazuli, benitoite, azurmalachite
Hardness	3.5 - 4

STABILITY

Reaction to heat	sensitive
Stability to light	stable
Reaction to chemicals	attacked by acids

Azurmalachite



Mineral class	carbonates
Mineral species	Is a rock composed of azurite (carbonate) and malachite (carbonate)
Crystal system	monoclinic (both)
Chemical composition	azurite - $Cu_3(CO_3)_2(OH)_2$; and malachite - $Cu_2CO_3(OH)_2$
Trade names	azurmalachite
Color	dark blue and green together
Transparency	generally opaque
Luster	vitreous to waxy
Optical phenomena	none
Refractive Indices	azurite 1.730 – 1.840; and malachite 1.655 – 1.909
Optic character	biaxial positive azurite; and biaxial negative malachite; DR
Birefringence	azurite .106 and malachite .254
Dispersion	none
Pleochroism	medium, light blue and dark blue, restrict for non opaque azurite
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	variable 3.25 to 4.10;
Fracture	conchoidal to irregular, greasy to dull luster (azurite); and irregular to splintery dull luster (malachite)
Cleavage	perfect, in two directions, usually obscured
Identifying characteristics	appearance
Possible treatments	impregnation with paraffin or epoxy resin
Possibly mistaken with	azurite, malachite, lapis lazuli, chlorastolite, azurmalachite imitation
Hardness	3.5 – 4

STABILITY

Reaction to heat	sensitive
Stability to light	stable
Reaction to chemicals	attacked by acids

Benitoite

Mineral class	silicates
Group	benitoite
Mineral species	benitoite
Crystal system	hexagonal
Chemical composition	$BaTiSi_3O_9$
Trade names	benitoite and by color
Color	blue, blue purplish and pink (rare)
Transparency	transparent
Luster	vitreous to sub-adamantine
Optical phenomena	none
Refractive Indices	1.757 – 1.804
Optic character	DR, uniaxial positive
Birefringence	.047
Dispersion	.044
Pleochroism	blue – strong, colorless and blue
Flourescence	strong chalky blue (SW), inert (LW)
Absorption spectra	not diagnostic
Specific gravity	3.68 (+ .01, - .07)
Fracture	conchoidal to irregular, with vitreous luster
Cleavage	indistinct in one direction
Identifying characteristics	often with color zoning; moderatelly high dispersion, intense pleochroism and high birefringence
Possible treatments	unknown
Possibly mistaken with	azurite, iolite, natural and synthetic sapphire
Hardness	6 – 6.5

STABILITY

Reaction to heat	sensitive with rapid changes in temperature
Stability to light	stable
Reaction to chemicals	slowly attacked by concentrated hydrochloric acid; attacked by hydrofluoric acid

Beryllonite

Mineral class	phosphates
Crystal system	monoclinic (pseudo-orthorhombic simmetry)
Chemical composition	$NaBePO_4$
Trade names	beryllonite
Color	colorless, white, light yellow
Transparency	transparent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.552 – 1.561
Optic character	biaxial negative; DR
Birefringence	.009
Dispersion	.010
Pleochroism	none
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	2.80 – 2.85
Fracture	conchoidal, with pearly luster
Cleavage	very difficult in one direction, almost never seen
Identifying characteristics	liquid or tubular inclusions
Possible treatments	unknown
Possibly mistaken with	beryl, quartz, scapolite, amblygonite
Hardness	5.5 – 6

STABILITY

Reaction to heat	sensitive
Stability to light	stable
Reaction to chemicals	soluble in acids

Cassiterite

Mineral class	oxides
Group	rutile
Mineral species	cassiterite
Crystal system	tetragonal
Chemical composition	SnO_2
Trade names	cassiterite, tin stone, wood-tin, resin tin
Color	dark brown to black, yellowish brown, yellow or colorless with brown bands
Transparency	transparent to opaque
Luster	sub-adamantine to adamantine
Optical phenomena	none
Refractive Indices	1.997 – 2.093 (+ .009, - .006)
Optic character	DR, uniaxial positive
Birefringence	.096 to .098
Dispersion	.071
Pleochroism	weak to moderate, light and dark brown
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	6.95 (± .08)
Fracture	conchoidal to irregular, sub-adamantine to adamantine luster
Cleavage	imperfect in one direction
Identifying characteristics	combination of properties
Possible treatments	unknown
Possibly mistaken with	scheelite, sphene, hematite, zircon and cuprite
Hardness	6 – 7

STABILITY

Reaction to heat	stable, except when it shows liquid inclusions
Stability to light	stable
Reaction to chemicals	attacked very slightly

Childrenite

Mineral class	phosphates
Crystal system	orthorhombic
Chemical composition	$(Fe, Mn)AlPO_4(OH)_2.H_2O$
Trade names	childrenite
Color	golden yellow, brown to yellowish brown
Transparency	transparent to opaque
Luster	vitreous to resinous
Optical phenomena	none
Refractive Indices	1.63 – 1.685
Optic character	biaxial negative; DR
Birefringence	.030 to .040
Dispersion	strong
Pleochroism	medium - yellow, pink, pale pink to colorless
Flourescence	inert
Absorption spectra	strong line in 410 nm and weak in 490 nm
Specific gravity	3.20
Fracture	conchoidal to irregular
Cleavage	imperfect
Identifying characteristics	combination of properties
Possible treatments	unknown
Possibly mistaken with	apatite, danburite, phenakite
Hardness	5

STABILITY

Reaction to heat	unavailable
Stability to light	stable
Reaction to chemicals	unavailable

Clinohumite

Mineral class	silicates
Group	humite
Mineral species	clinohumite
Crystal system	monoclinic
Chemical composition	$Mg(OH, F)_2.4Mg_2(SiO_4)$
Variety	clinohumite
Trade names	clinohumite
Color	brown, yellow, white
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.629 – 1.674
Optic character	biaxial positive, DR
Birefringence	.028 to .041
Dispersion	none
Pleochroism	variable; light yellow, orangish yellow
Flourescence	weak orangish yellow (SW), ocasionally orange to golden yellow (LW)
Absorption spectra	band nearly 415 nm
Specific gravity	3.17 - 3.35
Fracture	conchoidal
Cleavage	poor, in one direction
Identifying characteristics	color and growth zoning; fluid inclusions
Possible treatments	unknown
Possibly mistaken with	hessonite garnet and spessartine garnet
Hardness	6

STABILITY

Reaction to heat	unavailable
Stability to light	stable
Reaction to chemicals	gelatinizes

Cuprite

Mineral class	oxides
Mineral species	cuprite
Crystal system	cubic
Chemical composition	Cu_2O
Trade names	cuprite, red cooper ore; misnomers: cooper ruby
Color	purplish red to brownish red to almost black
Transparency	transparent to opaque
Luster	adamantine to sub-metallic
Optical phenomena	none
Índice de refração	2.849 (±.001)
Optic character	SR
Birefringence	none
Dispersion	none
Pleochroism	none
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	6.14 (+.01, -.29)
Fracture	conchoidal to irregular, adamantine luster
Cleavage	imperfect, usually not detectable
Identifying characteristics	brownish red streak
Possible treatments	unknown
Possibly mistaken with	sphalerite, cassiterite
Hardness	3.5 - 4

STABILITY

Reaction to heat	fuses under the jeweler's torch
Stability to light	stable
Reaction to chemicals	soluble in hydrochloric and nitric acids

Danburite

Mineral class	silicates
Mineral species	danburite
Crystal system	orthorhombic
Chemical composition	$CaB_2(SiO_4)_2$
Trade names	danburite and by color
Color	colorless to ligh yellow to brown; often pink
Transparency	transparent to translucent
Luster	vitreous to resinous
Optical phenomena	none
Refractive Indices	1.630 – 1.636 (± .003)
Optic character	DR, biaxial positive / negative
Birefringence	.006
Dispersion	.016
Pleochroism	none
Flourescence	inert to strong, light blue to green-blue (LW), weaker (SW)
Absorption spectra	may show a doublet around 580 nm
Specific gravity	3.00 (± .03)
Fracture	irregular to sub-conchoidal, with vitreous to greasy luster
Cleavage	none
Identifying characteristics	combination of properties
Possible treatments	unknown
Possibly mistaken with	apatite, andalusite, topaz, barite and tourmaline
Hardness	7

STABILITY

Reaction to heat	fuses under the jeweler's torch
Stability to light	stable
Reaction to chemicals	very slowly attacked by hydrochloric acid and hydrofluoric acid

Datolite

Mineral class	silicates
Mineral species	datolite
Crystal system	monoclinic
Chemical composition	$CaBSiO_4(OH)$
Trade names	datolite and by color
Color	colorless, white, light green, light yellow, brown, gray, pink, violet
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.626 – 1.670 (-.04)
Optic character	biaxial negative, DR; AGG
Birefringence	.044 a .046
Dispersion	.016
Pleochroism	weak to none
Flourescence	inert to moderate blue (SW)
Absorption spectra	not diagnostic
Specific gravity	2.95 (±.05)
Fracture	conchoidal to irregular, vitreous luster
Cleavage	none
Identifying characteristics	combination of properties
Possible treatments	unknown
Possibly mistaken with	smithsonite, amblygonite
Hardness	5 – 5.5

STABILITY

Reaction to heat	fuses easily under the jeweler's torch
Stability to light	stable
Reaction to chemicals	attacked slowly by concentrated hydrochloric acid

Diaspore

Mineral class	hydroxides
Mineral species	diaspore
Crystal system	orthorhombic
Chemical composition	AlO(OH) + Mn
Trade names	diaspore, sultanite
Color	light green, colorless, light brown, light pink to dark red, light yellow, white
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	chatoyancy; ocasionally color change, often greenish brown (under daylight or fluorescent light) to pinkish brown (incandescent light)
Refractive Indices	1.702 – 1.750 (+.02)
Optic character	biaxial positive, DR; AGG
Birefringence	.048
Pleochroism	strong – blue-violet, light green, pink to dark red
Flourescence	inert to weak; light and dull yellow (SW); turkish gems - green (SW)
Absorption spectra	not diagnostic; turkish gems - broads bands at 471nm, 463 nm and 454 nm, line at 701 nm
Specific gravity	3.30 to 3.50; turkish 3.39
Fracture	conchoidal
Cleavage	perfect in one direction
Identifying characteristics	combination of properties
Possible treatments	unknown
Possibly mistaken with	gibbsite
Hardness	6.5 - 7

STABILITY

Reaction to heat	decomposes under flame without fuse
Stability to light	stable
Reaction to chemicals	stable in acids

Dioptase

Mineral class	silicates
Mineral species	dioptase
Crystal system	hexagonal (trigonal)
Chemical composition	$CuSiO_2(OH)_2$
Trade names	dioptase
Color	Intense bluish green
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.655 – 1.708 (± .012)
Optic character	DR, uniaxial positive
Birefringence	.051 to .053
Pleochroism	weak
Flourescence	inert
Absorption spectra	broad band at 550 nm
Specific gravity	3.30 (± .05)
Fracture	conchoidal to irregular, with greasy luster
Cleavage	perfect in three directions
Identifying characteristics	Intense green color, high birefringence and cleavage
Possible treatments	unknown
Possibly mistaken with	emerald, synthetic emerald, diopside, peridot and zoisite
Hardness	5

STABILITY

Reaction to heat	sensitive
Stability to light	stable
Reaction to chemicals	attacked by acids, hydrochloric acid stains blue

Ekanite

Mineral class	silicates
Mineral species	ekanite
Crystal system	originally crystallized in the tetragonal system and then comverted to a metamictic, amorphous state
Chemical composition	$(Th,U)(Ca,Fe,Pb)_2 Si_8O_{20}$
Trade names	ekanite
Color	dark green to brown
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	asterism with four rays
Refractive Indices	1.597
Optic character	SR
Birefringence	none
Pleochroism	none
Flourescence	undeterminated
Absorption spectra	not diagnostic
Specific gravity	3.28
Fracture	conchoidal, with vitreous luster
Cleavage	none
Identifying characteristics	radioactivity
Possible treatments	unknown
Possibly mistaken with	pectolite, phosphophyllite, brazilianite
Hardness	6 – 6.5

STABILITY

Reaction to heat	undeterminated
Stability to light	stable
Reaction to chemicals	attacked by hydrofluoric acid

Enstatite

Mineral class	silicates
Group	pyroxene
Mineral species	enstatite
Crystal system	orthorhombic
Chemical composition	$MgSiO_3$
Variety	bronzite
Trade names	enstatite and bronzite
Color	reddish brown to brownish green, yellowish green; rarely colorless
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	chatoyancy and asterism with six rays (rare)
Refractive Indices	1.663 – 1.673 (± .010)
Optic character	DR, biaxial positive
Birefringence	.008 to .011
Pleochroism	weak to strong, green and yellowish green or brown and yellow
Flourescence	inert
Absorption spectra	directional, lines at 505 and 550 nm
Specific gravity	3.25 (+ .015, - .02)
Fracture	irregular, vitreous to pearly luster
Cleavage	distinct in two directions
Identifying characteristics	combination of properties
Possible treatments	unknown
Possibly mistaken with	axinite, kornerupine, diopside and zoisite
Hardness	5 - 6

STABILITY

Reaction to heat	sensitive
Stability to light	stable
Reaction to chemicals	slowly attacked by hydrofluoric acid

Gahnospinel

Mineral class	oxides
Group	spinel
Mineral species	series between spinel and gahnite
Crystal system	cubic
Chemical composition	$(Mg, Zn)Al_2O_4$
Trade names	gahnospinel
Color	green or blue, usually dark tones
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.760 (± .020)
Optic character	SR
Birefringence	none
Pleochroism	none
Flourescence	inert
Specific gravity	4.01 (± .40)
Fracture	conchoidal, with vitreous luster
Cleavage	indistinct, rarely seen
Identifying characteristics	combination of properties
Possible treatments	unknown
Possibly mistaken with	natural and synthetic sapphire
Hardness	7.5 - 8

STABILITY

Reaction to heat	unavailable
Stability to light	stable
Reaction to chemicals	unavailable

Hemimorphite

Mineral class	silicates
Mineral species	hemimorphite
Crystal system	orthorhombic
Chemical composition	$Zn_4Si_2O_7(OH)_2.H_2O$
Trade names	hemimorphite, calamine
Color	usually colorless, but may be green, blue, yellow or brown; sometimes banded
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.614 – 1.636 (± .03)
Optic character	biaxial positive, DR; AGG
Birefringence	.022
Dispersion	.013
Pleochroism	inert to weak
Flourescence	generally inert
Absorption spectra	not diagnostic
Specific gravity	3.45 (±.05)
Fracture	irregular to subconchoidal, with vitreous luster
Cleavage	perfect in two directions
Identifying characteristics	combination of properties, may be banded
Possible treatments	unknown
Possibly mistaken with	smithsonite
Hardness	4.5 - 5

STABILITY

Reaction to heat	fuses with difficulty, decrepitates
Stability to light	stable
Reaction to chemicals	gelatinizes easily with acids

Herderite

Mineral class	phosphates
Mineral species	herderite
Crystal system	monoclinic
Chemical composition	CaBe (F,OH) [PO_4]
Trade names	herderite, glucinite, allogonite
Color	colorless, gray, light yellow, light blue, light green
Transparency	transparent to translucent
Luster	vitreous to subvitreous
Optical phenomena	none
Refractive Indices	1.592 (+ .012 – .005) – 1.621 (+.006 – .002)
Optic character	biaxial, positive or negative
Birefringence	.023 to .032
Dispersion	.008 to .009
Pleochroism	none
Flourescence	ocasionally; blue (LW), violet or greenish
Absorption spectra	not diagnostic
Specific gravity	2.95 (± .05)
Fracture	subconchoidal
Cleavage	indistinct, in one direction
Identifying characteristics	none
Possible treatments	unknown
Possibly mistaken with	melinophane, clinohumite
Hardness	5 – 5.5

STABILITY:

Reaction to heat	sensitive
Stability to light	stable
Reaction to chemicals	unavailable

Idocrase

Mineral class	silicates
Mineral species	idocrase
Crystal system	tetragonal
Chemical composition	$Ca_{10}Mg_2Al_4(SiO_4)_5(Si_2O_7)_2(OH)_4$
Variety	californite, cyprine and xanthite
Trade names	californite, cyprine and xanthite
Color	yellow to green, yellowish brown, light blue to greenish blue, gray and white.
Transparency	transparent to opaque
Luster	vitreous to greasy
Optical phenomena	none
Refractive Indices	1.713 – 1.718 (+ .003, - .013), spot reading usually 1.71
Optic character	AGG, DR, uniaxial, positive or negative, strain colors are common
Birefringence	.001 to .012
Dispersion	.019
Pleochroism	none to weak
Flourescence	inert
Absorption spectra	464 nm line, weaker line at 528,5 nm
Specific gravity	3.40 (+ .10 - .15)
Fracture	conchoidal to irregular to granular, with vitreous to dull luster
Cleavage	indistinct, rarely seen
Identifying characteristics	combination of properties
Possible treatments	none
Possibly mistaken with	hydrogrossular, jadeite, spinel, epidote, kyanite, zoisite and nephrite
Hardness	6.5

STABILITY

Reaction to heat	fuses easily
Stability to light	stable
Reaction to chemicals	attacked by hydrochloric acid

Kornerupine

Mineral class	silicates
Mineral species	kornerupine
Crystal system	orthorhombic
Chemical composition	$Mg_3Al_6(Si,Al,B)_5O_{21}(OH)$
Trade names	kornerupine
Color	yellowish green to brownish green, blue-green, yellow, brown and colorless (rare)
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	chatoyancy and asterism (very rare)
Refractive Indices	1.667 – 1.680 (± .003)
Optic character	DR, biaxial negative (strongly negative), may show pseudo-uniaxial optic figure
Birefringence	.012 to .017
Dispersion	.019
Pleochroism	generally strong; brownish green samples – green, yellow and brown-red
Flourescence	inert to strong, yellow (SW and LW)
Absorption spectra	band at 503 nm
Specific gravity	3.30 (+ .05, - .03)
Fracture	conchoidal, with vitreous luster
Cleavage	perfect in two directions
Identifying characteristics	combination of properties
Possible treatments	unknown
Possibly mistaken with	axinite, spodumene, diopside, tourmaline, sinhalite and enstatite
Hardness	6 - 7

STABILITY

Reaction to heat	unavailable
Stability to light	stable
Reaction to chemicals	insoluble in acids

Kyanite

Mineral class	silicates
Group	kyanite
Crystal system	triclinic
Chemical composition	Al_2SiO_5
Trade names	kyanite
Color	usually light to dark blue to green; may be yellow, gray, brown or colorless; gem speciments often zoned in blue, green and colorless bands
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	chatoyancy (rare)
Refractive Indices	1.716 – 1.731 (± .004)
Optic character	DR, biaxial negative
Birefringence	.012 a .017
Dispersion	.020
Pleochroism	blue – moderate, colorless, dark blue and violet-blue
Flourescence	red, weak (LW)
Absorption spectra	bands at 435 and 445 nm
Specific gravity	3.68 (+ .01, - .12)
Fracture	irregular, with vitreous to pearly luster
Cleavage	perfect in one direction, distinct in one diretion
Identifying characteristics	commonly color zoned, may appear fibrous
Possible treatments	unknown
Possibly mistaken with	epidote, idocrase, sapphire, tanzanite, iolite and spinel
Hardness	4 – 5 in one direction, 6 – 7.5 at 90º to it

STABILITY

Reaction to heat	very sensitive
Stability to light	stable
Reaction to chemicals	not attacked by acids

Maw-sit-sit

Crystal system	is a rock, not a sole mineral
Chemical composition	varies depending on mineral content; rock composed primarlly of ureyite (a pyroxene) and minerals of the following groups: amphibole, chlorite and feldspar
Trade names	maw-sit-sit
Color	saturated green, with dark green to black veining or mottling
Transparency	opaque
Luster	waxy to vitreous
Optical phenomena	none
Refractive Indices	Spot reading 1,53 a 1,74; often show multiple readings due to different minerals present
Optic character	AGG
Birefringence	none
Pleochroism	none
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	2.77 (+.38, -.31)
Fracture	granular, with dull luster
Cleavage	none
Identifying characteristics	veined and mottling, black spots of kosmochlor concentrations
Possible treatments	unknown
Possibly mistaken with	jadeite, nephrite, serpentine, hydrogrossular
Hardness	6

STABILITY

Reaction to heat	unavailable
Stability to light	stable
Reaction to chemicals	variable with mineral content

Montebrasite

Mineral class	phosphates
Group	amblygonite
Mineral species	montebrasite and amblygonite
Crystal system	triclinic
Chemical composition	$(Li,Na)Al(PO_4)(F,OH)$
Trade names	montebrasite, amblygonite and by color
Color	usually colorless to light yellow to greenish yellow; may be light pink, green, blue or brown
Transparency	transparent
Luster	greasy to vitreous
Optical phenomena	none
Refractive Indices	1.612 – 1.636 (- .034)
Optic character	DR, biaxial may be either positive (montebrasite) or negative (amblygonite)
Birefringence	.020 to .027
Pleochroism	weak to none
Flourescence	very weak, green (LW), phosphoresces blue light (LW e SW)
Absorption spectra	not diagnostic
Specific gravity	3.02 (± .04)
Fracture	conchoidal, with pearly to vitreous luster
Cleavage	perfect in one direction, good in other direction
Identifying characteristics	Veil-like inclusions, clouds in parallel bands following cleavage directions
Possible treatments	unknown
Possibly mistaken with	brazilianite, tourmaline, datolite and phosphophyllite
Hardness	5.5 – 6

STABILITY

Reaction to heat	very sensitive, will crack when heated unevenly
Stability to light	stable
Reaction to chemicals	attacked by many acids

Pectolite

Mineral class	silicates
Mineral species	pectolite
Crystal system	triclinic
Chemical composition	$NaCa_2Si_3O_8(OH)$
Variety	larimar
Trade names	pectolite and larimar (blue)
Color	slightly gray to yellowish white, green, blue; sometimes very light pink
Transparency	Semitransparent to opaque
Luster	vitreous to silky
Optical phenomena	chatoyancy
Refractive Indices	1.599 – 1.628 (+ .017, - .004); spot reading 1.60
Optic character	DR, biaxial positive; AGG
Birefringence	.029 to .38
Pleochroism	none
Flourescence	greenish yellow to orange - inert to moderate (SW and LW, often stronger SW), may phosphoresce
Absorption spectra	not diagnostic
Specific gravity	2.81 (+ .09, - .07)
Fracture	conchoidal to splintery, with vitreous to silky luster
Cleavage	perfect in two directions, usually darken by aggregate structure
Identifying characteristics	none
Possible treatments	unknown
Possibly mistaken with	turquoise, dyed howlite and ekanite
Hardness	4.5 – 5

STABILITY

Reaction to heat	fuses easily
Stability to light	stable
Reaction to chemicals	merge in hydrochloric acid

Petalite

Mineral class	silicates
Mineral species	petalite
Crystal system	monoclinic
Chemical composition	$LiAlSi_4O_{10}$
Variety	castorite
Trade names	petalite and castorite
Color	colorless, gray; sometimes yellow, pink or very light green
Transparency	transparent to translucent
Luster	vitreous to pearly
Optical phenomena	chatoyancy (rare)
Refractive Indices	1.504 – 1.516 (+ .006, - .002)
Optic character	DR, biaxial positive
Birefringence	.012 to .016
Pleochroism	none
Flourescence	inert to weak, orange (LW)
Absorption spectra	not diagnostic
Specific gravity	2.40 (+ .06, - .01)
Fracture	subconchoidal, vitreous to pearly luster
Cleavage	perfect in one direction, distinct in two directions
Identifying characteristics	vitreous appearance and combination of properties
Possible treatments	unknown
Possibly mistaken with	orthoclase
Hardness	6 – 6.5

STABILITY

Reaction to heat	not sensitive
Stability to light	stable
Reaction to chemicals	attacked by hydrofluoric acid

Phenakite

Mineral class	silicates
Mineral species	phenakite
Crystal system	hexagonal (trigonal)
Chemical composition	Be_2SiO_4
Trade names	phenakite
Color	usually colorless to light yellow; also light brown, pink and greenish blue (rare)
Transparency	transparent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.654 – 1.670 (+ .026, - .004)
Optic character	DR, uniaxial positive
Birefringence	.016
Dispersion	.015
Pleochroism	moderate to weak
Flourescence	inert to weak; pink, light blue or green (SW and LW)
Absorption spectra	not diagnostic
Specific gravity	2.95 (± .05)
Fracture	conchoidal, with vitreous luster
Cleavage	indistinct, rarely seen
Identifying characteristics	combination of properties
Possible treatments	unknown
Possibly mistaken with	spodumene and euclase
Hardness	7.5 – 8

STABILITY

Reaction to heat	not fusible
Stability to light	stable
Reaction to chemicals	not attacked by acids

Prehnite

Mineral class	silicates
Mineral species	Prehnite
Crystal system	orthorhombic
Chemical composition	$Ca_2Al_2Si_3O_{10}(OH)_2 + Fe$
Trade names	Prehnite
Color	light and dark green, yellowish green, yellow, colorless, white, gray
Transparency	transparent (rare) to translucent
Luster	vitreous to pearly
Optical phenomena	chatoyancy
Refractive Indices	1.611 – 1.665; spot reading 1.63
Optic character	biaxial positive; AGG
Birefringence	.021 to .033
Dispersion	none
Pleochroism	none
Flourescence	brownish dull yellow
Absorption spectra	not diagnostic
Specific gravity	2.80 to 3.00 gem quality material usually 2.88 to 2.94
Fracture	irregular
Cleavage	good in one direction
Identifying characteristics	combination of properties
Possible treatments	unknown
Possibly mistaken with	chrysoprase, jadeite, nephrite, hemimorphite
Hardness	6 – 6.5

STABILITY

Reaction to heat	very sensitive and fuses under jeweler's torch
Stability to light	stable
Reaction to chemicals	react in contact with hydrochloric acid

Rutile

Mineral class	oxides
Group	rutile
Mineral species	rutile
Crystal system	tetragonal
Chemical composition	TiO_2
Trade names	rutile
Color	black, deep red, brownish red, dark green, greenish, bluish and violet
Transparency	opaque to transparent
Luster	metallic to sub-adamantine
Optical phenomena	none
Refractive Indices	2.616 – 2.903
Optic character	DR, uniaxial positive
Birefringence	.287
Dispersion	.330
Pleochroism	distinct, red to brown, yellow and green
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	4.26 (± .03)
Fracture	conchoidal to irregular, sub-adamantine luster
Cleavage	distinct in one diretion
Identifying characteristics	combination of properties
Possible treatments	unknown
Possibly mistaken with	diamond, zircon, strontium titanate, sphene, cubic zirconia, GGG and YAG
Hardness	6 – 6.5

STABILITY

Reaction to heat	heat may cause color change
Stability to light	stable
Reaction to chemicals	Resistant to acids

Scheelite

Mineral class	wolframates
Mineral species	scheelite
Crystal system	tetragonal
Chemical composition	$CaWO_4$ + Mo
Trade names	scheelite, by color
Color	colorless, white, gray, yellowish white, yellow-orange, violet, reddish, brownish, greenish
Transparency	transparent to translucent
Luster	vitreous to adamantine
Optical phenomena	none
Refractive Indices	1.918 – 1.937
Optic character	uniaxial positive, DR
Birefringence	.016
Dispersion	.038
Pleochroism	weak
Flourescence	Inet (LW); colorless stones - strong light blue (SW), orange stones - yellowish (SW)
Absorption spectra	584 nm doublet (usually none in orange stones)
Specific gravity	5.90 – 6.30
Fracture	sub-conchoidal to irregular
Cleavage	distinct in one diretion
Identifying characteristics	combination of properties; high dispersion
Possible treatments	unknown
Possibly mistaken with	sphalerite, sphene
Hardness	4.5 - 5

STABILITY

Reaction to heat	practically infusible
Stability to light	stable
Reaction to chemicals	attacked by acids

Sillimanite

Mineral class	silicates
Mineral species	sillimanite
Crystal system	orthorhombic
Chemical composition	Al_2SiO_5
Variety	cat's-eye sillimanite
Trade names	sillimanite, cat's-eye sillimanite
Color	white to gray, brown, green; purplish blue to grayish blue (rare).
Transparency	generally translucent to opaque, rarely transparent
Luster	vitreous to silky
Optical phenomena	chatoyancy
Refractive Indices	1.659 – 1.680 (+ .004, - .006)
Optic character	DR, biaxial positive; AGG
Birefringence	.015 to .021
Dispersion	.015
Pleochroism	blue samples - strong; colorless, light yellow and blue
Flourescence	blue samples - weak; red (LW and SW)
Absorption spectra	weak 410, 441 and 462 nm bands
Specific gravity	3.25 (+ .02, - .11)
Fracture	irregular, vitreous to silky luster
Cleavage	perfect in one direction
Identifying characteristics	combination of properties
Possible treatments	unknown
Possibly mistaken with	euclase, spodumene, cat's-eye tourmaline, jadeite and nephrite
Hardness	6 – 7.5

STABILITY

Reaction to heat	sensitive
Stability to light	stable
Reaction to chemicals	not attacked by acids

Sinhalite

Mineral class	oxides
Mineral species	sinhalite
Crystal system	orthorhombic
Chemical composition	$MgAlBO_4$
Trade names	sinhalite and by color
Color	greenish yellow to brownish yellow, brown; light pink (rare)
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.668 – 1.707 (+ .005, - .003)
Optic character	RD, biaxial strongly negative
Birefringence	.036 to .039
Dispersion	.017
Pleochroism	moderate, light and dark brown and greenish brown
Flourescence	inert
Absorption spectra	452, 463, 475 and 493 nm lines
Specific gravity	3.48 (± .02)
Fracture	conchoidal, wit vitreous luster
Cleavage	indistinct, rarely seen
Identifying characteristics	combination of properties
Possible treatments	unknown
Possibly mistaken with	peridot, tourmaline, zircon, chrysoberyl and kornerupine
Hardness	6.5 – 7

STABILITY

Reaction to heat	unavailable
Stability to light	stable
Reaction to chemicals	unavailable

Smithsonite

Mineral class	carbonates
Mineral species	smithsonite
Crystal system	hexagonal (trigonal)
Chemical composition	$ZnCO_3$
Variety	bonamite (bluish green)
Trade names	smithsonite, bonamite
Color	blue, green, yellow, colorless, white, pink and light brown; often banded
Transparency	transparent (rare) to semitranslucent
Luster	vitreous to sub-vitreous
Optical phenomena	none
Refractive Indices	1.621 – 1.849
Optic character	uniaxial negative, DR; AGG
Birefringence	.225 to .228
Dispersion	.037
Pleochroism	none
Flourescence	inert to strong, various colors
Absorption spectra	variable
Specific gravity	4.30 (+.15)
Fracture	splintery to irregular, with dull to vitreous luster
Cleavage	perfect in three directions, usually obscured by aggregate structure
Identifying characteristics	high birefringence and specific gravity
Possible treatments	unknown
Possibly mistaken with	chrysoprase, datolite, rhodochrosite, barite, hemimorphite, jadeite, nephrite
Hardness	4 - 5

STABILITY

Reaction to heat	sensitive
Stability to light	stable
Reaction to chemicals	efferverces to hydrochloric acid

Sphalerite

Mineral class	sulphides
Group	sphalerite
Mineral species	sphalerite
Crystal system	cubic
Chemical composition	(Zn,Fe)S
Variety	marmatite and cleiophane
Trade names	sphalerite, marmatite (black), cleiophane (almost colorless to light green)
Color	green, yellow, orange, red, brown; often with color zoning; rarely colorless; non gem quality material gray to black
Transparency	transparent to opaque
Luster	adamantine to sub-adamantine
Optical phenomena	none
Refractive Indices	2.369 – 2.50 (increases with iron content)
Optic character	SR
Birefringence	none
Dispersion	.156
Pleochroism	none
Flourescence	generally inert, sometimes moderate to strong, orange-red (SW and LW)
Absorption spectra	651, 667, 690 nm lines
Specific gravity	4.05 (+ .05, - .15)
Fracture	conchoidal to irregular, with adamantine to resinous luster
Cleavage	perfect in six diretions, easily developed
Identifying characteristics	very strong dispersion, color zoning common; surface cleavages often evident on rough samples
Possible treatments	unknown
Possibly mistaken with	andradite, zircon, spessartine, diamond, sphene, scheelite and cuprite
Hardness	3.5 – 4

STABILITY

Reaction to heat	sensitive
Stability to light	stable
Reaction to chemicals	attacked by hydrochloric acid, emits rotten egg odor

Staurolite

Mineral class	silicates
Mineral species	staurolite
Crystal system	monoclinic
Chemical composition	$(Fe, Mg, Zn)_2Al_9(Si,Al)_4O_{22}(OH)_2$
Trade names	twinned crystals also designed cross stone, maltese cross, Saint Andrew´s cross and lucky stone
Color	brown to black, occurs in transparent reddish brown (rare)
Transparency	transparent to opaque
Luster	vitreous to resinous
Optical phenomena	none
Refractive Indices	1.736 – 1.746 (±.015)
Optic character	biaxial positive, DR; AGG
Birefringence	.009 to .015
Dispersion	.021
Pleochroism	transparent brown samples – moderate yellow to reddish yellow, brownish and colorless
Flourescence	inert
Absorption spectra	sometimes a strong line near 450 nm and a weaker line near 580 nm; very rarely strong bands at 610 and 632 nm and weak band at 532 nm
Specific gravity	3.71 (+.08, -.06)
Fracture	conchoidal to irregular, with dull to vitreous luster
Cleavage	distinct in one direction
Identifying characteristics	twinned crystals at 90° or 60° to one other
Possible treatments	wax or plastic coating or impregnation
Possibly mistaken with	chrysoberyl
Hardness	7 – 7.5

STABILITY

Reaction to heat	infusible
Stability to light	stable
Reaction to chemicals	slightly attacked by acids

Sugilite

Mineral class	silicates
Mineral species	sugilite
Crystal system	hexagonal
Chemical composition	$(K,Na)(Na,Fe)_2(Li_2Fe)Si_{12}O_30$
Trade names	sugilite, royal azel, royal lavulite
Color	purple-red to bluish purple, rarely pink
Transparency	semitransparent to opaque
Luster	waxy to vitreous
Optical phenomena	none
Refractive Indices	1.607 – 1.610 (+.001, -.002); may also show reading around 1.54 from quartz impuritites
Optic character	uniaxial negative, DR; AGG
Birefringence	.003; usually not detectable
Dispersion	unavailable
Pleochroism	none
Flourescence	inert
Absorption spectra	550 nm band, 411, 419, 437 and 445 nm lines
Specific gravity	2.74 (+.05)
Fracture	granular, with dull luster
Cleavage	none
Identifying characteristics	intense purple color, combination of properties
Possible treatments	thermal treatment at 450°C, approximately, may lighten color
Possibly mistaken with	charoite, chalcedony
Hardness	5.5 – 6.5

STABILITY

Reaction to heat	stable
Stability to light	stable
Reaction to chemicals	attacked by hydrofluoric acid

Taaffeite

Mineral class	oxides
Mineral species	taaffeite
Crystal system	hexagonal
Chemical composition	$MgBeAl_4O_8$
Trade names	taaffeite
Color	pink to red, blue, violet, purple, brown and colorless
Transparency	transparent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.719 – 1.723 (± .002)
Optic character	DR, uniaxial negative
Birefringence	.004 to .005
Dispersion	.019
Pleochroism	none
Flourescence	inert to weak, green (SW and LW)
Absorption spectra	weak band at 458 nm, not diagnostic
Specific gravity	3.61 (± .01)
Fracture	conchoidal, vitreous luster
Cleavage	none
Identifying characteristics	combination of properties
Possible treatments	unknown
Possibly mistaken with	spinel
Hardness	8 – 8.5

STABILITY

Reaction to heat	unavailable
Stability to light	stable
Reaction to chemicals	not attacked

Thomsonite

Mineral class	silicates
Group	zeolite
Mineral species	thomsonite
Crystal system	orthorhombic
Chemical composition	$NaCa_2Al_5Si_5O_20_6H_2O$
Variety	okarkite, lintonite and gibsonite
Trade names	okarkite (white), lintonite (translucid green) and gibsonite (pink)
Color	various colors, including brown, yellow, orange, pink, green, white and gray
Transparency	translucent to opaque
Luster	silky to vitreous
Optical phenomena	none
Refractive Indices	1.515 – 1.540 (+ .015, - .018), spot reading 1,52.
Optic character	AGG; DR
Birefringence	.025 (usually not detectable)
Pleochroism	none
Flourescence	inert to moderate patchy brown and white (LW)
Absorption spectra	not diagnostic
Specific gravity	2.35 (+ .05, - .10)
Fracture	irregular, with dull to silky luster
Cleavage	perfect in one direction (usually obscured in aggregates)
Identifying characteristics	bands or mottling; strucuture tipically of radiating shperical aggegates producing eye-like forms
Possible treatments	unknown
Possibly mistaken with	chalcedony, calcite, thulite and unakite
Hardness	5 – 5.5

STABILITY

Reaction to heat	fuses and swells under the jeweler's torch
Stability to light	stable
Reaction to chemicals	attacked by acids

Tugtupite

Mineral class	silicates
Mineral species	tugtupite
Crystal system	tetragonal
Chemical composition	$Na_4AlBeSi_4O_{12}Cl$
Trade names	tugtupite, reindeer stone
Color	usually pink to red, white, gray or black mottled; very rarely light blue
Transparency	translucent to opaque
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.496 – 1.502
Optic character	uniaxial positive, DR; AGG
Birefringence	.006 (usually not detectable)
Dispersion	none
Pleochroism	none in aggregates; individual crystals - moderate Intensity, purplish red and orange-red
Flourescence	red parts – medium to strong, orange (LW) and orangish red (SW), may phosphoresce
Absorption spectra	not diagnostic
Specific gravity	2.36 (+.21, -.06)
Fracture	irregular to conchoidal, with vitreous to greasy luster
Cleavage	none
Identifying characteristics	mottled coloring and combination of properties
Possible treatments	unknown
Possibly mistaken with	chalcedony, common opal
Hardness	4 – 6.5

STABILITY

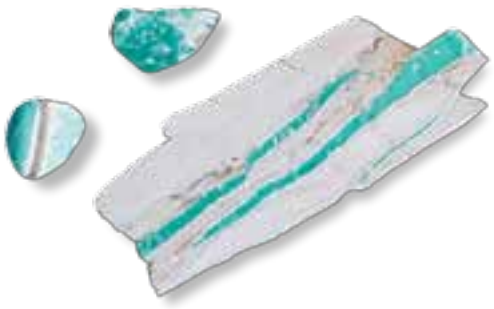
Reaction to heat	unavailable
Stability to light	stable
Reaction to chemicals	unavailable

Unakite

Mineral class	is a rock, not a sole mineral
Chemical composition	varies depending on mineral content: green epidote, white to gray quartz and pink feldspar
Trade names	unakite
Color	green, white to gray, and pink, mottled pattern; may contain black veining
Transparency	opaque
Luster	greasy to vitreous
Optical phenomena	none
Refractive Indices	spot reading around 1.74 to 1.76, 1.55 or 1.52, depending on tested area
Optic character	Opaque
Birefringence	none
Dispersion	none
Pleochroism	none
Flourescence	usually inert
Absorption spectra	not diagnostic
Specific gravity	3.00 (+.2. -.15)
Fracture	granular to irregular, with dull luster
Cleavage	none
Identifying characteristics	mottled coloring, black veining
Possible treatments	unknown
Possibly mistaken with	hydrogrossular garnet, rhodonite
Hardness	6 - 7

STABILITY

Reaction to heat	unavailable
Stability to light	stable
Reaction to chemicals	attacked by hydrofluoric acid

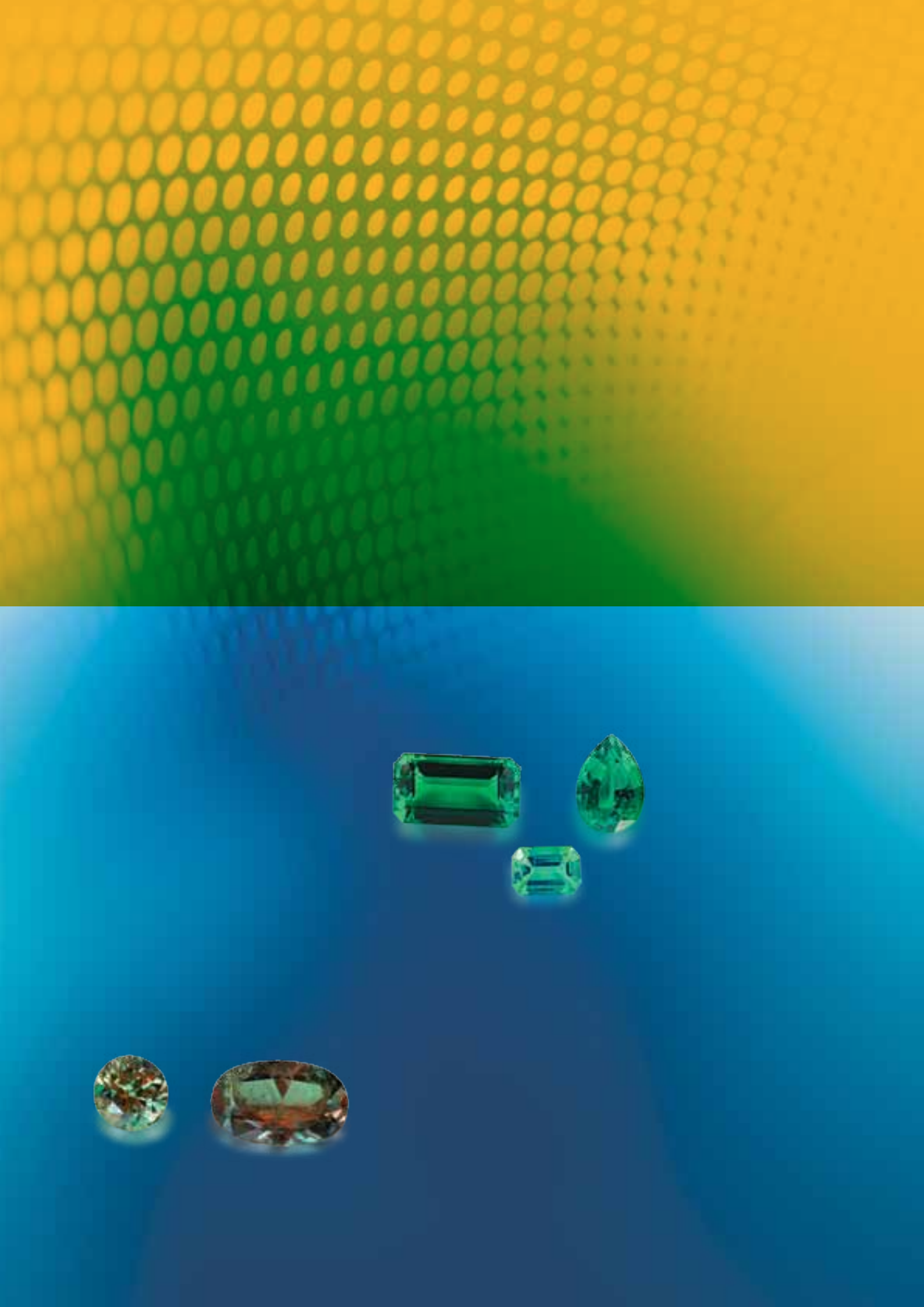


Variscite

Mineral class	oxides
Mineral species	variscite
Crystal system	orthorhombic
Chemical composition	$AlPO_4.2H_2O$
Variety	utahlite
Trade names	variscite, amatrice, utahlite and sabalite or trainite; misnomers: California turquoise, Nevada turquoise and Utah turquoise
Color	light to medium yellowish green to bluish green; often mottled or veined with yellow to brown matrix
Transparency	translucent to opaque
Luster	waxy to vitreous
Optical phenomena	none
Refractive Indices	1.560 – 1.590 (+ .003, - .006); spot reading 1.57
Optic character	AGG; DR
Birefringence	usually not detectable
Pleochroism	none
Flourescence	inert to weak, green (SW and LW)
Absorption spectra	lines, strong at 688 nm and weaker at 650 nm
Specific gravity	2.50 (± .10)
Fracture	granular to irregular, with dull luster
Cleavage	none
Identifying characteristics	yellow to brown matrix; stone appears pinkish through the color filter
Possible treatments	unknown
Possibly mistaken with	green turquoise, serpentine, jadeite, nephrite and malachite
Hardness	3.5 – 5

STABILITY

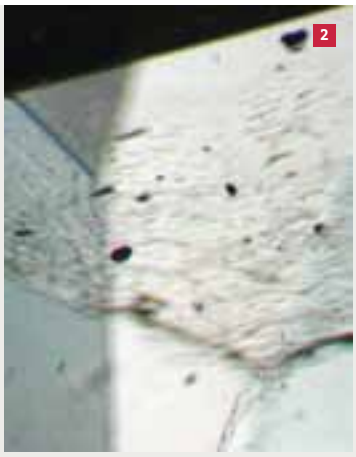
Reaction to heat	sensitive
Stability to light	stable
Reaction to chemicals	attacked by acids

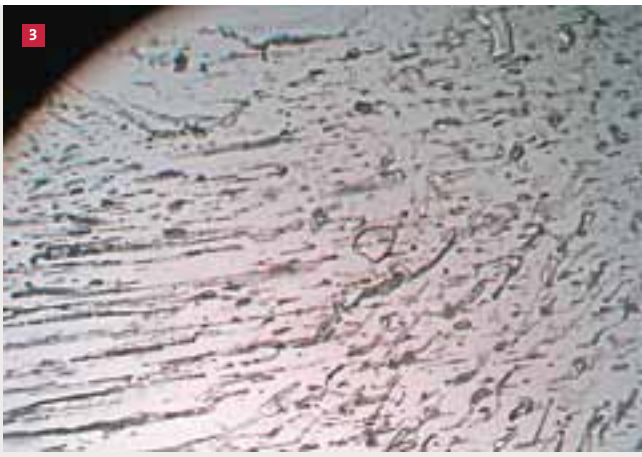


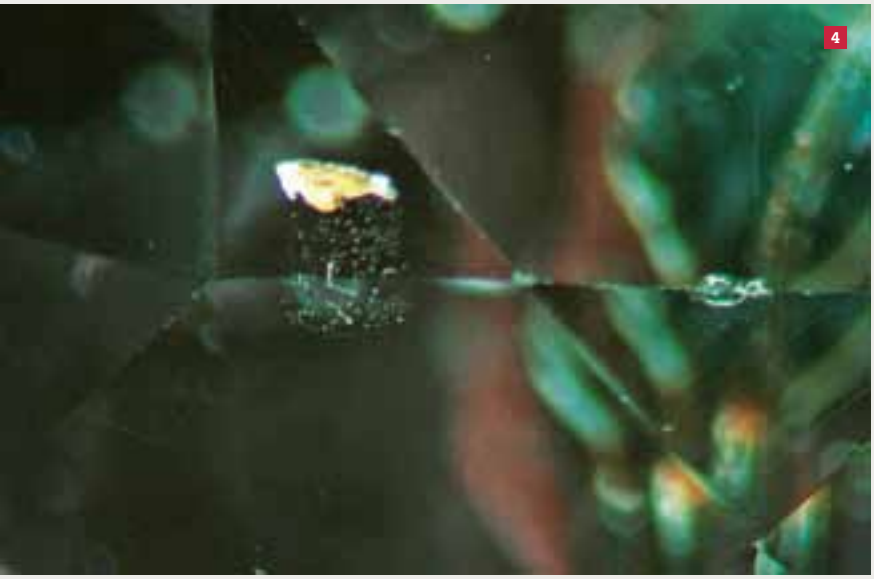
SYNTHETIC GEMS SPECIFICATIONS

Synthetic Alexandrite

Nature of Material	synthetic
Crystal system	orthorhombic
Chemical composition	$BeAl_2O_4$
Variety	synthetic alexandrite and cat's-eye synthetic alexandrite
Trade names	wrong: Alexandria-created alexandrite, Inamori-created alexandrite, Inamori-created cat's-eye alexandrite
Color	bluish green in daylight, brownish red to red-purple in incandescent light
Transparency	transparent
Luster	vitreous
Optical phenomena	color change and chatoyancy
Refractive Indices	1.746 – 1.755 (- .006)
Optic character	DR, biaxial positive
Birefringence	.008 to .010
Dispersion	.015
Pleochroism	strong - green, orange, and purple-red
Flourescence	moderate to strong red (LW and SW); cat's-eye variety - moderate red (LW), may show weak chalky yellow near surface, with underlying weak red-orange (SW)
Specific gravity	3.73 (± .02)
Fracture	conchoidal, with vitreous to greasy luster
Cleavage	none
Identifying characteristics	• flux – flux feathers, residues and tubes, parallel planes of flux, hexagonal, triangular or trapezoidal metallic platelets, straight growth lines • Czochralski - needle-like inclusions, curved striae • floating zone – gas bubbles, swirled appearance • cat's-eye – undulating growth lines
Possible treatments	fracture fillings and heat shock
Possibly mistaken with	synthetic corundum, natural alexandrite, natural cat's-eye alexandrite
Hardness	8.5
STABILITY	
Reaction to heat	generally stable
Stability to light	generally stable
Reaction to chemicals	stable







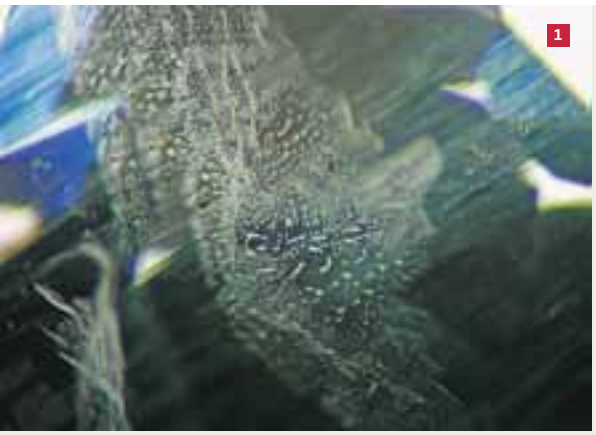
1, 3 e 5 > fluid inclusions
2 > platinum inclusions
4 > fluid inclusions and flux residues

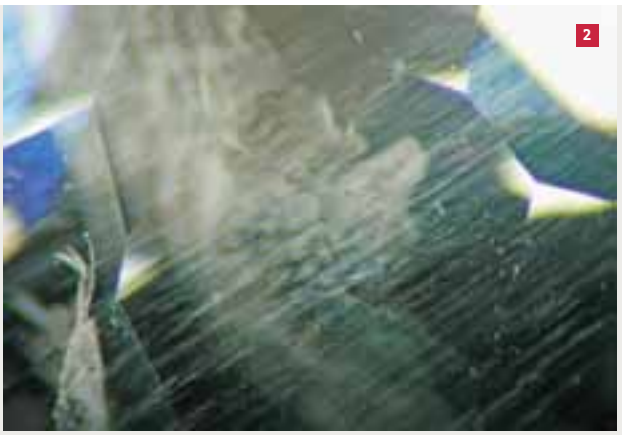
Synthetic Beryl

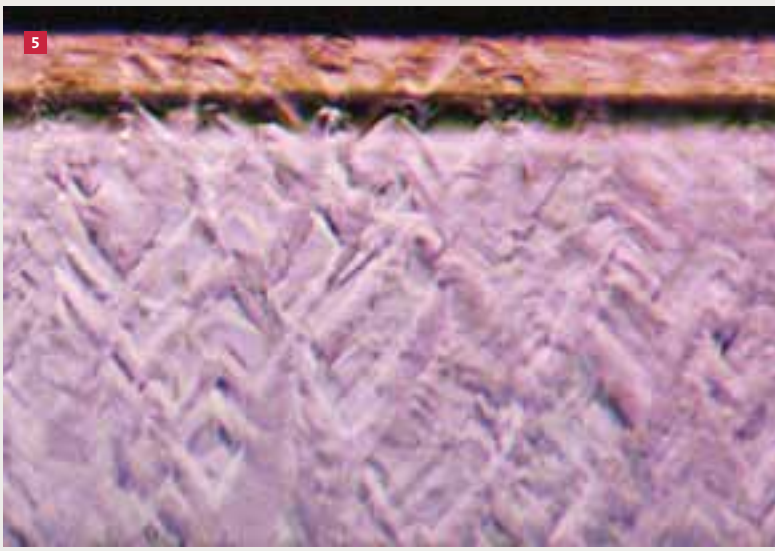
Nature of Material	synthetic
Crystal system	hexagonal
Chemical composition	$Be_3Al_2Si_6O_{18}$
Varietys	synthetic hydrothermal red beryl, synthetic hydrothermal aquamarine, synthetic flux aquamarine (experimental)
Trade names	synthetic aquamarine, synthetic red beryl, synthetic "bixibite" (proposed name to red variety, not accepted)
Color	orangish red to purplish red, greenish blue to green-blue
Transparency	transparent
Luster	vitreous
Optical phenomena	none
Refractive indices	• hydrothermal - 1.573 – 1.588 (+ .008, -.003) • flux – 1.564 – 1.561 (±.010)
Optic character	DR, uniaxial negative
Birefringence	.005 to .008
Dispersion	.014
Pleochroism	• blue material - moderate to strong, green and bluish green • red material – very strong to strong, pale pink to purplish pink
Flourescence	inert
Absorption spectrum	red material - two bands at 550 and 494 nm
Specific gravity	• hydrothermal - 2.68 (±.03) • flux - 2.66 (+.03, -.01)
Fracture	conchoidal, with vitreous to waxy luster
Cleavage	very difficult in one direction, almost never seen; basal
Identifying characteristics	distinct delimitation between colorless seed and red beryl; hexagonal platelets, probably hematite; Irregular multhi-phase cavities; liquid and two-phase feather-like structures; flux residues
Possible treatments	it's possible to eliminate yellow features if these are due to additional iron content by heat treatment at temperatures between 400 and 450°C
Possibly mistaken with	aquamarine, composite gems, glasses, blue topaz, synthetic quartz, synthetic spinel, maxixe beryl (treated by irradiation), red beryl, imperial topaz
Hardness	7.5 - 8

STABILITY

Reaction to heat	generally not sensitive, may contain liquid inclusions
Stability to Light	stable
Reaction to chemicals	attacked by hydrofluoric acid



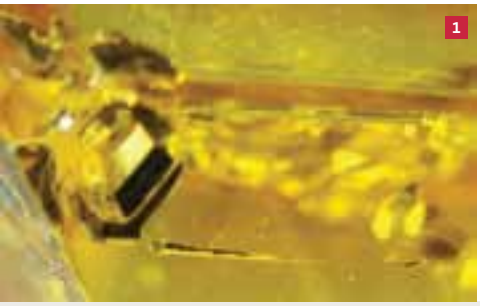


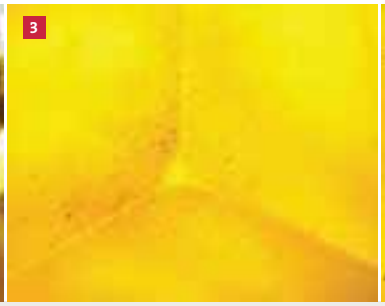
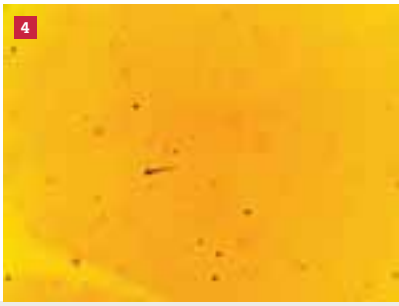


1 > fluid inclusions in synthetic aquamarine
2 > parallel orientated fluid inclusions in synthetic aquamarine
3 > aligned fluid inclusions and black inclusions in synthetic aquamarine
4 and 5 > growth structure in synthetic red beryl

Synthetic Diamond

Nature of Material	synthetic
Sistema cristalização	cubic
Chemical composition	C
Varietys	CVD synthetic diamond and HPHT synthetic diamond
Trade names	laboratory diamond, synthetic diamond, CVD synthetic diamond and HPHT synthetic diamond
Color	colorless; very light to very dark yellow, gray, brown, blue, green, orange, pink, red and purple
Transparency	transparent to opaque
Luster de polimento	adamantine
Optical phenomena	none
Refractive Indices	2.417
Optic character	SR
Birefringence	none
Dispersion	.044
Pleocraísmo	none
Fluorescence	• natural colors (not treated) – the intensity of UVC flourescence is usually bigger than UVL. Often the luminescence is badly distributed being able to be visible in square shaped or cruciform zoning • colorless to almost colorless samples – generally inert (UVL), blue, yellow, weak to strong green or orange (UVC). Moderate to strong yellow to greenish-yellow phosphorescence (UVC) during 60 seconds or more • blue samples - generally inert or light orange (UVL), green, yellow, yellow-green or light to moderate orange (UVC). Moderate to strong yellow phosphorescence (UVC), during 30 to 60 seconds • Yellow samples (greenish, orange and brownish), orange to pink and red – light to strong or inert yellow or green yellow (UVL, stronger under UVC). Usually phosphoresces yellow or light greenish yellow, during many seconds • Gray samples – generally inert or light orange (UVL) yellow, yellow-green or light to moderate orange • Treated (controlled thermal treatment HPHT) yellow and brown samples – green, green-yellow, yellow-green, yellow or moderate to strong orange (UVL and UVL). The luminescence intensity under UVC can be greater, lesser or equal to the UVL. Yellow or light to moderate green-yellow phosphorescence, often persistent • Treated (irradiation and controlled thermal treatment) pink samples - moderate to strong orange to red-orange (UVL), light to strong orange (UVC). Frequently the luminescence intensity under UVL is greater than UVC. Occasionally phosphoresces orange or light orange-red • Treated (irradiation and controlled thermal treatment) red and purple samples – inert or light to moderate orange or red-orange (UVL and UVC). The luminescence intensity under UVC can be greater, lesser or equal to the UVL. Often the luminescence is badly distributed being able to be visible in square shaped or cruciform zoning • Treated (irradiation) Green samples – very light to light orange-red (UVL), inert to light to moderate green-yellow, green or yellow-green. The luminescence intensity under UVC can be greater, lesser or equal to the UVL. Phosphorecence rarely seen. Often the luminescence is badly distributed being able to be visible in square shaped or cruciform zoning



1 and 2 > metallic inclusions
3 > growth detail
4 > metallic needles detail (300 x magnification)

Absorption spectrum	• Yellow and brown samples – strong absorption below 500 nm creates the yellow color; light and clear bands in 494 nm and 658 nm are due to nickel impurities • Green samples – increasing absorption in direction of both spectrum terminations, ascending the green color • Blue samples – increasing absorption in direction of the red extremity of the spectrum, ascending the blue color • Colorless samples – absence of clear absorption bands in the visible spectrum. • Treated (controlled thermal treatment HPHT) yellow and brown samples – strong absorption below 500 nm promoting the yellow-orange color; clear bands in 473, 658 and 732 nm due to nickel or complexes of nitrogen-nickel are intensified by the controlled thermal treatment • Treated (irradiation and controlled thermal treatment) pink samples – absorption bands in 575, 595, 637 and 741 nm indicate thermal and irradiation treatment; the pink colors due to strong band at 637 nm and the associated absorption between 500 and 600 nm • Treated (irradiation and controlled thermal treatment) red and purple samples – absorption bands in 503, 575, 595 and 637 nm indicate that the red color is due to irradiation and thermal treatment, while 732 and 473 nm bands are due to nickel or nickel-nitrogen complex • Treated (irradiation) green samples - clear absorption bands in 393, 412-43. 503, 595 and 741 nm indicate that green color is due to irradiation treatment
Specific gravity	3.52 (±.01)
Fracture	step-like to splintery, with adamantine luster
Cleavage	perfect in four directions
Identifying characteristics	Mettalic inclusions may cause magnetism, mettalic cloudy inclusions
Possible treatments	Controled heating HPHT, irradiation, fractures with resins, plastic coating
Possibly mistaken with	natural diamond, cubic zirconia, YAG, GGG, synthetic rutile, zircon, synthetic spinel, strontium titanate, synthetic sapphire, demantoid
Hardness	10

STABILITY

Reaction to heat	begins to vaporize in an oxygen-rich atmosphere at 690ºC to 875ºC
Stability to Light	stable
Reaction to chemicals	none

Synthetic Emerald

Nature of Material	synthetic
Crystal system	hexagonal
Chemical composition	$Be_3Al_2Si_6O_{18}$
Varietys	flux synthetic emerald, hydrothermal synthetic emerald
Trade names	Misnomers: Chatham emerald, Gilson emerald, cultured emerald
Color	medium to nearly dark green to bluish green
Transparency	transparent to translucent
Luster	vitreous
Optical phenomena	none
Refractive indices	• flux: • Chatham: 1.561 - 1.564 • Gilson type I: 1.564 – 1.567 • Gilson type II: 1.562 – 1.567 • Gilson type III (very rare): 1.571 – 1.579 • russian product: 1.559 – 1.563 • hydrothermal: 1.566 – 1.571 a 1.572 – 1.578
Optic character	DR, uniaxial negative
Birefringence	• flux: • Chatham: .003 • Gilson type I: .005 • Gilson type II: .005 • Gilson type III (very rare): .008 • russian product: .004 • hydrothermal: .005 a .006
Dispersion	.014
Pleochroism	moderate to strong, green and bluish green
Flourescence	• flux: • Chatham: weak to moderate red (LW and SW; LW stronger) • Gilson type I and II: generally weak to moderate red (LW and SW; LW stronger); some may fluoresce weak to moderate yellowish green, yellow or orange (LW and SW) • Gilson type III: inert (LW and SW) • russian product: weak to moderate orangish red (LW); inert (SW) • hydrothermal: moderate to strong red (LW and SW); Biron product - inert (LW and SW)

1 > Growth structure
2, 3 and 4 > fluid inclusions

Absorption spectrum	• distinct lines at 683 and 680.5 nm, less distinct lines at 662 e 646 nm, parcial absorption between 630 and 580 nm and almost complete absorption of the violet • Gilson type III (very rare) – additional line around 427 nm, often poorly defined and directional (i.e., shows up in certain directions through the crystal); very seldom seen in natural emeralds
Specific gravity	• Chatham, Gilson type I and II, russian flux-grown – 2.66 • Gilson type III (very rare): 2.68 to 2.69 • hydrothermal: 2.67 to 2.71
Fracture	conchoidal, with waxy to vitreous luster
Cleavage	very difficult in one direction, hardly ever seen; basal.
Identifying characteristics	• flux material – platinum crystals, phenakite crystals (colorless, low relief); flux (wisp veils or coarse flux which often appear white and in high relief, may appear two-phase), uniform parallel growth planes ("Venetian blind" effect) • hydrothermal materials – nailhead spicules (conical spaces extending from small phenakite crystals), minute two-phase inclusions in parallel lines (giving a cottony appearance), parallel tube-like cavities containing two-phase inclusions, sometimes a colorless seed plate (do not mistake for an assembled stone), metallic inclusions (gold or platinum)
Possible treatments:	• fracture or suface filling with a hardening substance (good stability); • oiling (oil may contain green dye) - hides flaws, improves transparency, may deepen color (medium to good stability) • dyeing - with colored oil
Possibly mistaken with	natural emerald, composite gems, glass, beryl, dioptase
Hardness	7.5 – 8.

STABILITY

Reaction to heat	may crack
Stability to Light	stable, oiled gems may lose color
Reaction to chemicals	not attacked by acids, except by hydrofluoric acid. acid may interrupt oiling treatment

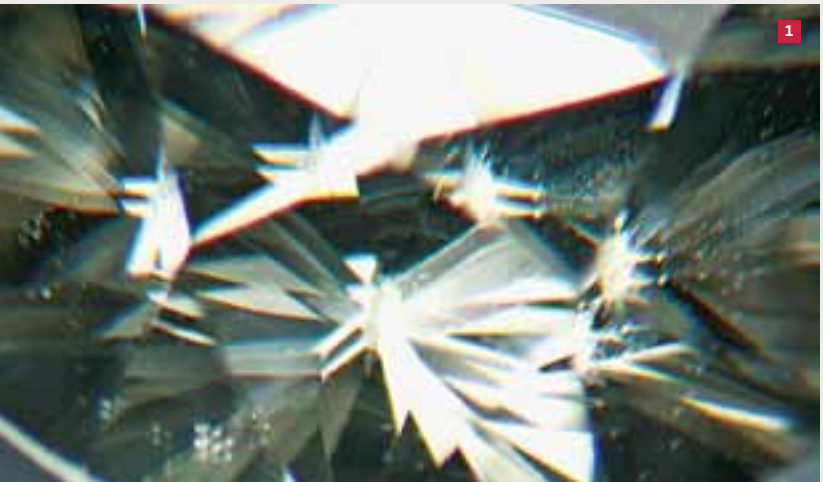
Synthetic Moissanite

Nature of Material	synthetic
Crystal system	hexagonal
Chemical composition	SiC
Trade names	Synthetic Moissanite, carborundum
Color	colorless, black, green, yellow
Transparency	transparent
Luster	subadamantine
Optical phenomena	none
Refractive Indices	2.648 – 2.691
Optic character	DR, uniaxial positive
Birefringence	.043
Dispersion	.104
Pleochroism	none known
Flourescence	inert to orange, usually LW, sometimes SW
Absorption spectrum	absorption between 400 nm and 425 nm
Specific gravity	3.22
Fracture	conchoidal
Cleavage	none; good partition
Identifying characteristics	White needles in parallel orientation to c-axis, generally perpendicular to the table facet; pinpoint or grouped inclusions; duplication of the pavillion edges
Possible treatments	none known
Possibly mistaken with	diamond, zircon, synthetic rutile, cubic zirconia
Hardness	9.25

STABILITY

Reaction to heat	stable
Stability to light	stable
Reaction to chemicals	stable

1 > Birefringence: facet edges duplication effect



2 > Needle-like inclusions

Synthetic Opal

Nature of Material	synthetic
Crystal system	amorphous
Chemical composition	$SiO_2.nH_2O$
Varietys	synthetic white opal, synthetic black opal, synthetic "fire-opal"
Trade names	synthetic opal
Color	white, gray to black, dark blue and orange bodycolors
Transparency	transparent to opaque
Luster	vitreous to resinous.
Optical phenomena	play-of-color (iridescence)
Refractive Indices	1.43 to 1.47
Optic character	UR, ADR (duble anomalous reaction) common due to tension
Birefringence	none
Dispersion	none
Pleochroism	none
Flourescence	• synthetic opal - more transparent to ultraviolet (especially LW) then natural opal • synthetic white opal - inert to strong, bluish white to blue (SW), moderate bluish white to yellow (LW); weak phosphorescence (rare) • synthetic fire-opal - inert to moderate, bluish white (SW); inert to moderate, blue or green (LW) • synthetic black opal - weak to strong, yellow to chalky yellowish green (SW); inert (LW); non phosphorescent
Absorption spectrum	not diagnostic
Specific gravity	1.97 - 2.20
Fracture	conchoidal to uneven, with subvitreous to waxy luster
Cleavage	none
Identifying characteristics	strong play-of-color in a mosaic pattern across its surface. Inside the mosaics, there is a cellular, chicken wire, snakeskin or scale-like structure, visible with magnification and overhead or back lighting. Sticks to tongue due to high porosity. White synthetic shows columnar structure viewed from the side. May show dendritic structure under high magnification and transmitted light
Possible treatments	not diagnostic
Possibly mistaken with	natural opal, glass and plastic imitation
Hardness	4.5 - 6

STABILITY

Reaction to heat	loses water; may crack in sudden changes of temperature; synthetic white or brownish opal might loses the play-of-color in overheating
Stability to Light	stable
Reaction to chemicals	attacked by acids and alcahols; hydrofluoric acid and caustic soda

Synthetic Periclase

Nature of Material	synthetic
Crystal system	cubic
Chemical composition	MgO
Trade names	synthetic periclase, lavernite
Color	colorless, light green, dark green, yellowish green, greenish yellow, light pink
Transparency	transparent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.737 (± .01)
Optic character	SR; ADR
Birefringence	none
Dispersion	.014
Pleochroism	none
Flourescence	• pink material: weak, pale orange (SW and LW) • other colors: inert
Absorption spectrum	not diagnostic
Specific gravity	3.76
Fracture	uneven
Cleavage	perfect, in three directions
Identifying characteristics	square negative crystals, gems in contact with air may show surface without polish due to oxidation
Possible treatments	none known
Possibly mistaken with	grossular garnet
Hardness	5 - 6

STABILITY

Reaction to heat	stable
Stability to light	stable
Reaction to chemicals	reacts to the suface to make a superficial brucite [$Mg(OH)_2$]

Synthetic Quartz

Nature of Material	synthetic
Crystal system	hexagonal (trigonal)
Chemical composition	SiO_2
Varietys	synthetic smoky quartz, synthetic amethyst, synthetic citrine, synthetic ametrine
Trade names	synthetic quartz, synthetic amethyst, synthetic citrine, synthetic ametrine; misnomers: reconstructed quartz, reconstructed amethyst, reconstructed citrine
Color	same colors of natural quatz, blue, greenish yellow and grayish green
Transparency	transparent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.544 - 1.553
Optic character	DR uniaxial positive
Birefringence	.009
Dispersion	.013
Pleochroism	weak to moderate
Flourescence	inert
Absorption spectrum	blue – 640 and 650 nm bands, weaker bands at 550 and 490 to 500 nm
Specific gravity	2.66 (+.03, -.02)
Fracture	conchoidal to uneven, with vitreous luster
Cleavage	none
Identifying characteristics	"breadcrumb" inclusions, two-phase spicule inclusions of gas and liquid (perpendicular to seed plate), color banding (parallel to seed plate), strain cracks (at angles to seed plate), absence of Brazil law twinning, flame-like twinning (under polariscope), "cobblestone" texture on crystal surfaces
Possible treatments	none known
Possibly mistaken with	natural quartz
Hardness	7

STABILITY

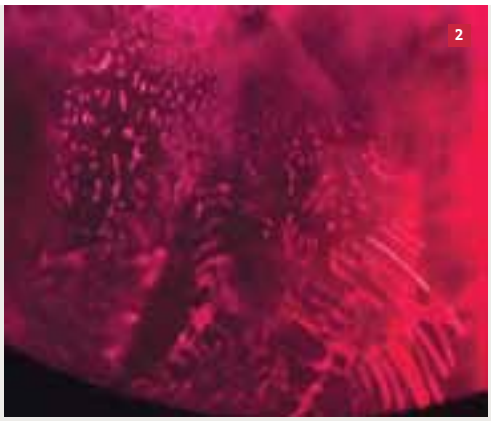
Reaction to heat	may crack in sudden changes of temperature; cracks or change color in high temperature
Stability to Light	loses color
Reaction to chemicals	attacked by hydrofluoric acid and fluoride ammonium, weakly soluble in alcalis

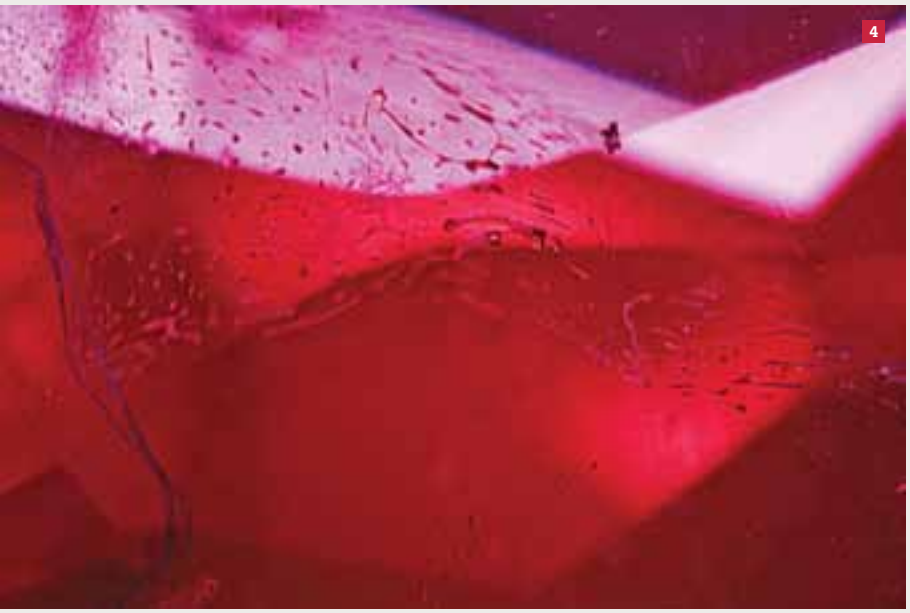
Synthetic Ruby

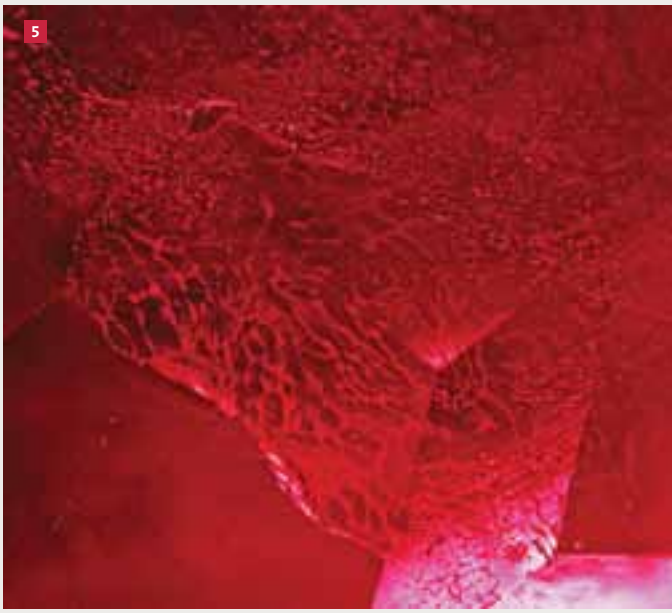
Nature of Material	synthetic
Crystal system	hexagonal (trigonal)
Chemical composition	Al_2O_3
Variety	synthetic ruby, synthetic cat's-eye ruby (rare), synthetic asteriated (star) ruby
Trade names	synthetic ruby
Color	all colors
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	Color change, asterism and chatoyancy (rare)
Refractive Indices	1.762 – 1.770 (+ .005, - .003)
Optic character	DR, uniaxial negative
Birefringence	.008
Dispersion	.018
Pleochroism	medium to strong purplish red, orange
Fluorescence	• synthetic ruby (flame fusion), reddish orange, very strong (LW) and medium to strong (SW); • synthetic ruby (flux) - strong reddish orange (less than flame fusion or natural) (LW) and medium to strong (SW)
Absorption spectrum	same as natural ruby, but usually more intense
Specific gravity	4.00 (± .05)
Fracture	conchoidal, with vitreous luster
Cleavage	none
Identifying characteristics	• flame fusion method – gas bubbles, curved growth lines, swaddling curvilinear color • flux method – veil-type inclusions, flux fingerprints, rustic cells and fine droplets of flux (white, yellowish or orange appearence), trapezoidal, triangular or hexagonal metal pratelets and retilinear or curvilinear growth lines • Czochralski method – gas bubbles and curved striae • "floating zone" method – gas bubbles and vortex appearance
Possible treatments	fracture filling and thermal shock
Possibly mistaken with	garnets, chrysoberyl, synthetic alexandrite, doublets and diamond
Hardness	9

STABILITY

Reaction to heat	can change color or affect optical phenomena
Stability to light	stable
Reaction to chemicals	attacked by boron solutions







1 > Flux detail
2 > synthetic environment / flux method
3 > synthetic typical cloud / flux method
4 and 5 > fingerprint with flux residues

Synthetic Rutile

Nature of Material	synthetic
Crystal system	tetragonal
Chemical composition	TiO_2
Trade names	tirum gem, titangem, brilliant titania, titania midnight stone, titanium, titanium rutile, titanstone, tania-59, astryl, briliante, diamothyst, jarra gem, kenya gem, kima gem, kimberlite gem, lusterite, star-tania
Color	usually light yellow, but might be blue, bluish green, orange or dark brown to nearly black
Transparency	transparent
Luster	subadamantine to submetallic
Optical phenomena	none
Refractive Indices	2.616 – 2.903
Optic character	DR, uniaxial positive
Birefringence	.287
Dispersion	.330
Pleochroism	light yellow, weak to none
Flourescence	inert
Absorption spectrum	yellow and blue – cutoff below 430 nm
Specific gravity	4.26 (± .03)
Fracture	conchoidal to uneven, with subadamantine luster
Cleavage	none
Identifying characteristics	extreme dispersion, extreme doubling, generally flawless but may present gas bubbles
Possible treatments	light yellow material used as diamond simulant results from heat treating of very dark colored boules
Possibly mistaken with	diamond, zircon, strontium titanate, sphene, CZ, GGG and YAG
Hardness	6 – 6.5

STABILITY

Reaction to heat	extreme heat may cause a change in color
Stability to light	stable
Reaction to chemicals	resistant to most acids and alkalis

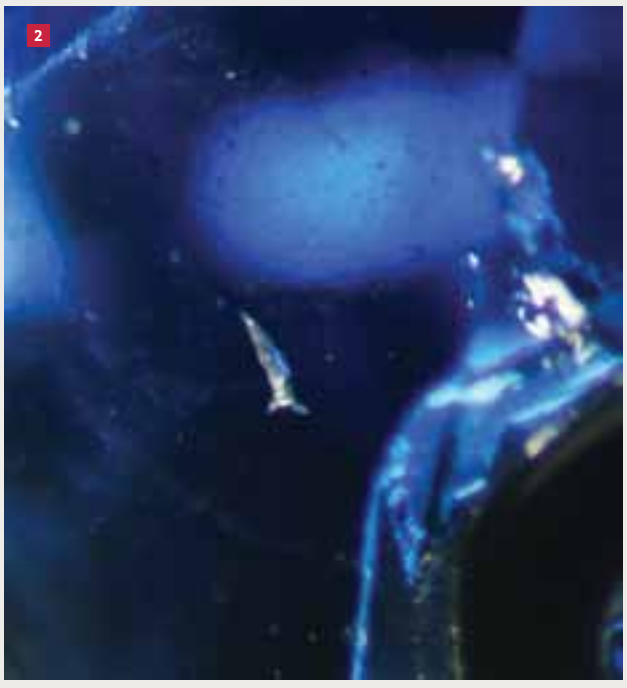
Synthetic Sapphire

Nature of Material	synthetic
Crystal system	hexagonal (trigonal)
Chemical composition	Al_2O_3
Variety	synthetic sapphire, synthetic asteriated (star) sapphire, synthetic cat's-eye sapphire (rare)
Trade names	synthetic sapphire; misnomers: synthetic garnet, synthetic amethist, alexandrite
Color	all colors
Transparency	transparent to opaque
Luster	vitreous
Optical phenomena	color change, asterism and chatoyancy (rare)
Refractive Indices	1.762 – 1.770 (+ .005, - .003)
Optic character	DR, uniaxial negative
Birefringence	.008
Dispersion	.018
Pleochroism	moderate to strong, purplish blue and greenish
Flourescence	• orange samples – orange to light red (SW) • yellow samples – light red (SW) • green samples – light orange (LW) and brownish red (SW) • blue samples – waxy blue to yellowish green, weak to moderate (SW) • purple samples – strong red (LW), greenish blue (SW) • color change samples – orange to moderate red (LW and SW), can present phosphorescence red (LW) mottled blue (SW) • colorless samples – blue-white, inert to light (SW) • brown samples – red, inert to light (LW and SW) • pink samples – red, moderate to strong (LW), and reddish purple (SW)
Absorption spectrum	• blue samples – the ones produced by fusible material may show tenuous lines around 450nm and the other ones doesn't have a caracteristical spectrum • green samples – lines in 530 nm and 687 nm • color change samples – line at 474 nm • yellow and yellow-orange samples – line at 690 nm and no iron line is a strong synthetic indication; an alone cutoff at 460 nm also is a good synthetic indication • orange samples – narrow lines in red, fluorescent line in 690 nm
Specific gravity	4.00 (± .05)

Fracture	conchoidal, with vitreous luster
Cleavage	none
Identifying characteristics	• flame fusion samples - gas bubbles, curved growth lines, curved color bands • flux method samples – veil-type inclusions, flux fingerprints, rustic cells and fine droplets of flux (white, yellowish or orange appearence), trapezoidal, triangular or hexagonal metal pratelets and retilinear or curvilinear growth lines • czochralski samples - gas bubbles and curved lines • "floating zone" samples - gas bubbles and vortex appearance
Possible treatments	fracture fillings and thermal shock
Possibly mistaken with	natural corundum, garnet, chrysoberyl , synthetic alexandrite, doublets and diamond
Hardness	9

STABILITY

Reaction to heat	might change color or affect the optical phenomena
Stability to light	stable
Reaction to chemicals	sensitive to boron solutions



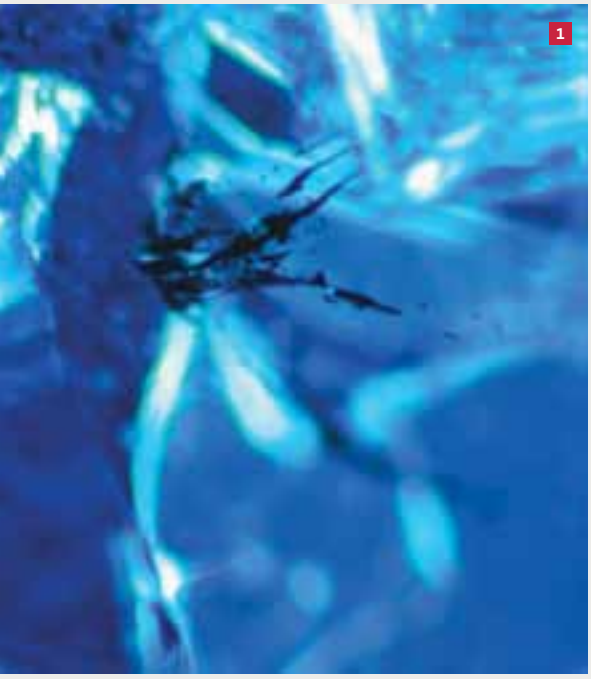
1 > partial fingerprint / flux method
2 > flux detail

Synthetic Spinel

Nature of Material	synthetic
Crystal system	cubic
Chemical composition	$MgAl_2O_4$
Variety	flame fusion, flux and hydrothermal synthetic spinel
Trade names	alumag, colorundolite, lustergem, magalux, radient, strongite, wesselton, aquagem, rozircon, berylite, dirigem, perigem, emerada, erinide; misnomers: synthetic aquamarine, synthetic peridot, brazilian emerald, Hope sapphire
Color	colorless, light to dark blue, yellow, light to dark green, purple, orange (rare), pink to red (rare), opaque dark blue (lapis lazuli imitation)
Transparency	usually transparent, ocasionally opaque
Luster	vitreous to subadamantine
Optical phenomena	color change
Refractive Indices	1.728 (+.012; -.008)
Optic character	SR, strong ADR, commonly with "cross-hatch" effect
Birefringence	none
Dispersion	.020
Pleochroism	none
Flourescence	• colorless samples – modearte to strong chalky blue (SW); sometimes weak green (LW) or strong greenish blue (SW) • light blue samples – weak to moderate orange (LW); chalky blue (SW) • medium blue samples – strong red (LW); strong bluish white (SW) • dark blue samples – strong red (LW); strong mottled blue (SW) • light green samples – strong yellowish green (LW); moderate yellowish green (SW) • dark green samples – strong purplish red (LW); strong greenish white (SW) • color change samples – moderate dull red (LW; weak chalky yellow (SW) • yellowish green samples – strong yellowish green (LW and SW) • red samples - strong red (LW); weak to moderate red (SW)
Absorption spectrum	variable, by the color
Specific gravity	3.64 (+.02;-.12)
Fracture	conchoidal, with vitreous luster
Cleavage	poorly developed, not seen in gems
Identifying characteristics	cross-hatch effect in the polariscope; generally flawless but may contain gas bubbles (may be thready or rarely, angular) or curved striae in red variety
Possible treatments	quench crackled - produces natural-appearing fractures
Possibly mistaken with	natural spinels, light green grossular, idocrase, chrysoberyl, natural and synthetic corundum
Hardness	8

STABILITY

Reaction to heat	may lose color in overheating
Stability to Light	stable
Reaction to chemicals	not attacked



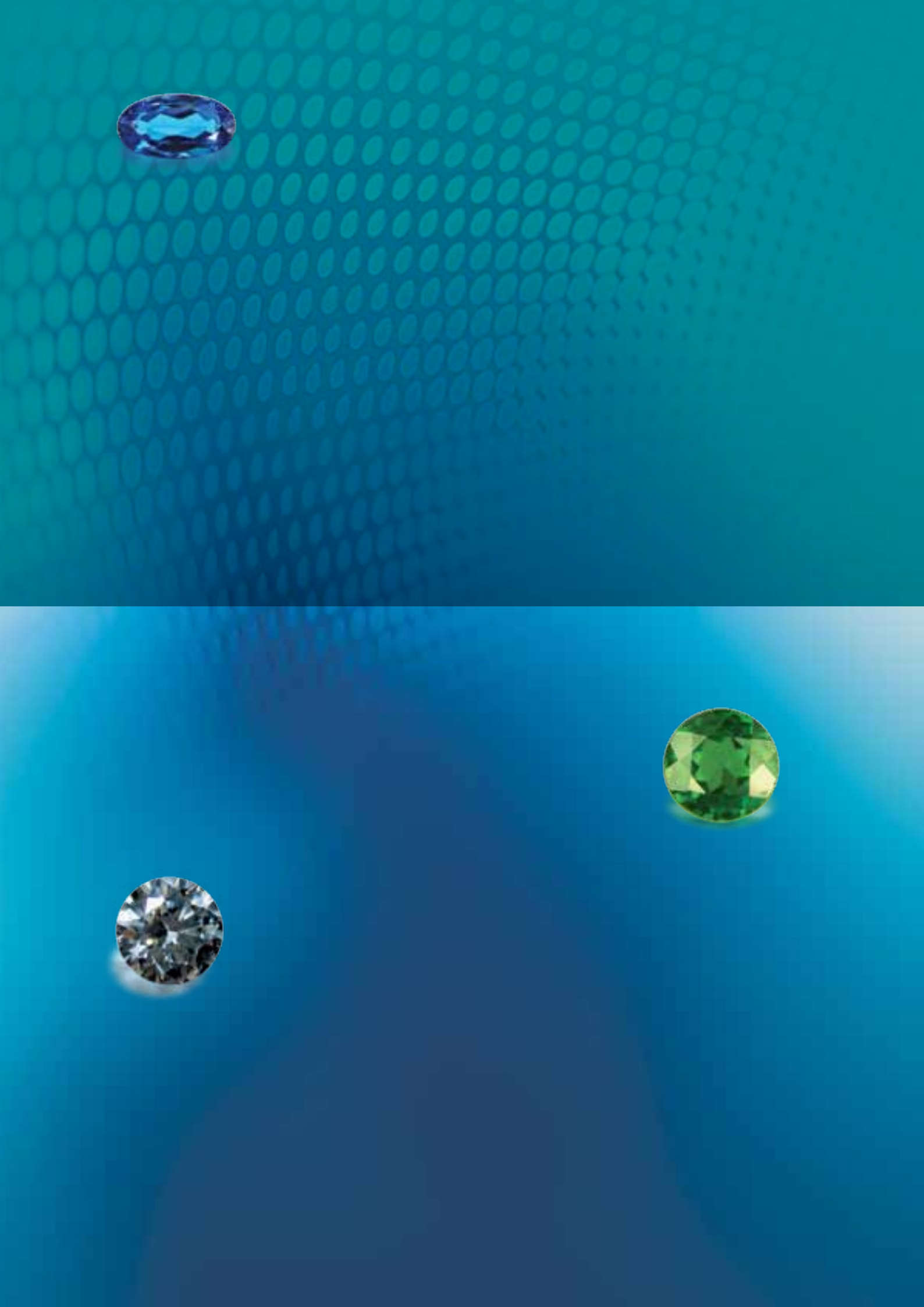
1 > Black inclusion in synthetic spinel /hydrothermal method
2 > “water in whisky” effect in synthetic spinel /flame fusion method

Synthetic Turquoise

Nature of Material	synthetic
Crystal system	trigonal
Chemical composition	$CuAl_6(PO_4)_4(OH)_8.5H_2O$
Trade names	Gilson synthetic turquoise, Gilson turquoise
Color	light to medium blue, sometimes spiderweb "matrix"
Transparency	semitranslucent to opaque
Luster	waxy to vitreous
Optical phenomena	none
Refractive Indices	1.610 - 1.650 usually 1.61 on “spot” reading
Optic character	DR, aggregate
Birefringence	usually not detected
Dispersion	none
Pleochroism	none
Flourescence	inert to weak, greenish yellow (LW), inert (SW)
Absorption spectrum	lacks the 432 nm line sometimes seen in natural turquoise
Specific gravity	2.76 (+ .14; -.36)
Fracture	conchoidal or granular
Cleavage	none
Identifying characteristics	tiny blue microspheres in a light colored groundmass ("cream-of-wheat" effect) under 30 or 50 power magnification; blue thread-like inclusions, artificial-looking black matrix
Possible treatments	none known
Possibly mistaken with	natural turquoise
Hardness	5 – 6

STABILITY

Reaction to heat	usually decrepitates (i.e., pieces "explode" off the mains mass until nothing remains) turns brown and colors the flame green
Stability to Light	stable
Reaction to chemicals	dissolves slowly in hydrochloric acid; may be discolored by specific gravity liquids, perpiration and cosmetics



ARTIFICIAL GEMS SPECIFICATIONS

Cubic Zirconia

Nature of Material	artificial
Sistema cristalino	cubic
Chemical composition	ZrO_2
Variety	cubic zirconia
Trade names	CZ, cubic zirconia, djevalite; misnomers: synthetic diamond, Z diamond, diamonair II, diamonesque, diamonite and zircon
Color	colorless, pink, blue, yellow, orangy, red, green, purple and brown
Transparency	transparent
Luster	subadamantine
Optical phenomena	none
Refractive Indices	2.15 (+ .030)
Optic character	SR
Birefringence	none
Dispersion	.060
Pleochroism	none
Flourescence	variable; greenish yellow or orangish yellow (LW), yellow (SW)
Absorption spectra	variable
Specific gravity	5.80 (± .20)
Fracture	conchoidal, with subadamantine luster
Cleavage	none
Identifying characteristics	generally pure, may have unsolved zircon oxide, bubble gas inclusions and fractures
Possible treatments	unknown
Possibly mistaken with	diamond, zircon, strontium titanate, sphene, synthetic rutile, GGG, YAG, spessartine and demantoid
Hardness	8.5

STABILITY

Reaction to heat	sensitive under high temperaure
Stability to light	stable
Reaction to chemicals	not attacked

GGG

Nature of material	artificial
Crystal system	cubic
Chemical composition	$Gd_3Ga_5O_{12}$
Trade names	GGG, 3G, triple-G and gadolinite
Color	usually colorless to light brown, yellow, orange, blue, red or green
Transparency	transparent
Luster	vitreous to sub-adamantine
Optical phenomena	none
Refractive Indices	1.970 (+ .060)
Optic character	RS
Birefringence	none
Dispersion	.045
Pleochroism	none
Flourescence	moderate to strong, pinkish orange (SW)
Absorption spectra	not diagnostic
Specific gravity	7.05 (+ .04, - .10)
Fracture	conchoidal, with vitreous to sub-adamantine luster
Cleavage	none
Identifying characteristics	almost transparent, generally without inclusions, may show gas bubbles
Possible treatments	unknown
Possibly mistaken with	diamond, zircon, strontium titanate, sphene, CZ, synthetic rutile, YAG and spessartine
Hardness	6.5

STABILITY

Reaction to heat	not sensitive
Stability to light	may turn gradually to brown under ultraviolet radiation and also sunlight (may become lighter with heat tratment)
Reaction to chemicals	not attacked

Lithium Niobate

Nature of Material	artificial
Crystal system	trigonal
Chemical composition	$LiNbO_3$
Trade names	lithium niobate, linobate
Color	colorless, red, green, yellow, blue, violet
Transparency	transparent
Luster	sub-adamantine
Optical phenomena	none
Refractive Indices	2.210 – 2.300
Optic character	uniaxial negative, RD
Birefringence	.090
Dispersion	.130
Pleochroism	medium to strong, in two tones of the hue
Flourescence	none
Absorption spectra	none
Specific gravity	4.65 (± .01)
Fracture	conchoidal to irregular, with vitreous luster
Cleavage	perfect in one direction
Identifying characteristics	strong dispersion, three or six sided inclusions
Possible treatments	unknown
Possibly mistaken with	diamond, synthetic diamond, synthetic moissanite, cubic zirconia, synthetic rutile, GGG, YAG, lithium tantalate
Hardness	5.5

STABILITY

Reaction to heat	stable
Stability to light	stable
Reaction to chemicals	stable

Lithium Tantalate

Nature of Material	artificial
Crystal system	trigonal
Chemical composition	$LiTaO_3$
Trade names	lithium tantalate
Color	colorless, yellowish
Transparency	transparent
Luster	sub-adamantine
Optical phenomena	none
Índice de refração	2.175 – 2.180
Optic character	uniaxial positive, DR
Birefringence	.005 to .006
Dispersion	.087
Pleochroism	unavailable
Flourescence	weak red-brown (LW)
Absorption spectra	unavailable
Specific gravity	7.30 – 7.50
Fracture	conchoidal, with vitreous luster
Cleavage	unavailable
Identifying characteristics	physical properties
Possible treatments	unknown
Possibly mistaken with	diamond, synthetic diamond, synthetic moissanite , cubic zirconia, synthetic rutile, GGG, YAG, lithium niobate
Hardness	5.5 - 6

STABILITY

Reaction to heat	stable
Stability to light	stable
Reaction to chemicals	stable

Minkovite

Nature of Material	artificial
Crystal system	monoclinic
Chemical composition	Y_2SiO_5
Trade names	minkovite, yttrium silicate
Color	purplish blue
Transparency	transparent
Luster	vitreous
Optical phenomena	none
Refractive Indices	1.785 – 1.810 (+.003)
Optic character	RD biaxial positive
Birefringence	.025
Pleochroism	strong: blue, light blue
Flourescence	chalky weak blue (LW) and inert (SW)
Absorption spectra	not diagnostic
Specific gravity	4.44 (±.01)
Fracture	conchoidal, with vitreous luster
Cleavage	none
Identifying characteristics	curved color lines; color concentration of dark blue in irregular tufts, white needles, angular small inclusions
Possible treatments	unknown
Possibly mistaken with	synthetic spinel, sapphire
Hardness	6.5

STABILITY

Reaction to heat	stable
Stability to light	stable
Reaction to chemicals	stable

Strontium Titanate

Nature of Material	artificial
Sistema cristalino	cubic
Chemical composition	$SrTiO_3$
Trade names	strontium titanate, fabulite, diagem, lustige, marvelite, sorella and zenithite; misnomers: synthetic diamond
Color	colorless
Transparency	transparent
Luster	vitreous to sub-adamantine
Optical phenomena	none
Refractive Indices	2.409
Optic character	SR
Birefringence	none
Dispersion	.190
Pleochroism	none
Flourescence	generally inert
Absorption spectra	not diagnostic
Specific gravity	5.13 (± .02)
Fracture	conchoidal, with vitreous luster
Cleavage	none
Identifying characteristics	very high dispersion, rare bubble gas Inclusions, often with bad polish due to low hardness
Possible treatments	unknown
Possibly mistaken with	diamond, zircon, YAG, sphene, CZ, synthetic rutile and GGG
Hardness	5 – 6

STABILITY

Reaction to heat	sensitive
Stability to light	stable
Reaction to chemicals	not attacked

YAG

Nature of Material	artificial
Sistema cristalino	cubic
Chemical composition	$Y_3Al_5O_{12}$
Trade names	YAG, aluminium yttrium garnet; misnomers: diamonair, diamogem, diamite, diamonique
Color	generally colorless, may be green, blue, pink, red, orange, yellow and purple
Transparency	transparent
Luster	vitreous to sub-adamantine
Optical phenomena	none
Refractive Indices	1.833 (± .010)
Optic character	SR
Birefringence	none
Dispersion	.028
Pleochroism	none
Flourescence	• colorless samples - inert to moderate, orange (LW); inert to weak, orange (SW) • blue and pink samples - inert (SW e LW) • green-yellow samples - very strong (LW e SW); phosphoresce • red-green samples - strong (LW) and red weak (SW)
Absorption spectra	unavailable
Specific gravity	4.50 to 4.60
Fracture	conchoidal to irregular, with vitreous to sub-adamantine luster
Cleavage	none
Identifying characteristics	perfectly transparent, usually free of inclusions, may show bubble gas inclusions
Possible treatments	unknown
Possibly mistaken with	diamond, zircon, strontium titanate, sphene, CZ, synthetic rutile, GGG, demantoid and spessartine
Hardness	8.5

STABILITY

Reaction to heat	not sensitive
Stability to light	stable
Reaction to chemicals	not attacked

IMITATIONS SPECIFICATIONS

Coral Imitation

Nature of material	imitation (Gilson)
Crystal system	amorphous
Chemical composition	calcite, silica and, probably, some iron oxide
Trade names	Gilson coral imitation, Coral imitation; misnomers: synthetic coral, Gilson coral
Color	light pink to dark red
Transparency	semitranslucent to opaque
Luster	sub-vitreous
Optical phenomena	none
Índice de refração	1.55
Optic character	aggregate
Birefringence	none
Pleochroism	none
Flourescence	variable (LW); inert (SW).
Absorption spectra	not diagnostic
Specific gravity	2.44
Fracture	granular, with dull luster
Cleavage	none
Identifying characteristics	no natural coral structure lines; granular and slim texture under high magnification
Possible treatments	unknown
Possibly mistaken with	coral
Hardness	3.5 - 4

STABILITY

Reaction to heat	gets darker under jeweler's torch
À luz	stable
Reaction to chemicals	efferverces in hydrochloric acid

Glass

Nature of material	imitation
Crystal system	amorphous
Chemical composition	silica and other materials
Trade names	strass, goldstone, slocum stone, alexandrium, aurora borealis
Color	all colors
Transparency	from transparent to opaque
Luster	vitreous
Optical phenomena	aventurescence; chatoyancy; color change ; iridescence; adularescence; simulated: orient, play-of-color and asterism
Refractive Indices	Usually 1.470 to 1.700
Optic character	SR, ADR strong
Birefringence	none
Dispersion	.009 to .098
Pleochroism	none
Flourescence	varies
Absorption spectra	varies
Specific gravity	2.30 to 4.50
Fracture	conchoidal; inclusions may cause an uneven to granular or splintery fracture
Cleavage	none
Identifying characteristics	bubble gas Inclusions, flow lines, mold mrks, "orange peel" effect, concave facets, rounded facet junctions
Possible treatments	various coatings
Possibly mistaken with	natural glass, plastic and natural gems
Hardness	5 - 6
STABILITY	
Reaction to heat	may fracture or break from rapid temperature changes; becomes viscous at relatively low temperatures
Stability to light	stable
Reaction to chemicals	may be attacked by acids, acid fumes, or even impurities in the air

Lapis Lazuli Imitation

Nature of material	imitation (Gilson)
Crystal system	amorphous
Chemical composition	sometimes presents pyrite
Trade names	Gilson lapis lazuli imitation, lapis lazuli imitation; (misnomers) synthetic lapis lazuli, Gilson lapis lazuli
Color	intense to medium blue to purplish blue
Transparency	opaque
Luster	waxy to vitreous
Optical phenomena	none
Índice de refração	very vague, around 1.53 to 1.55
Optic character	opaque
Pleochroism	none.
Flourescence	inert
Absorption spectra	not diagnostic
Specific gravity	2.33 to 2.53 frequently lower than lapis lazuli; the Gilson imitation is always very porous
Fracture	granular to irregular, with dull luster
Cleavage	none
Identifying characteristics	commonly contains pyrite and white calcite, white to light bue streak, distinctive flourescence, rarely presents striated or banded structure
Possible treatments	unknown
Possibly mistaken with	lapis lazuli, sodalite
Hardness	3

STABILITY

Reaction to heat	color may change
À luz	stable
Reaction to chemicals	acetone may discolorate; rapdly attacked by hydrochloric acid giving off the odor of rotten eggs



Plastic

Nature of material	imitation
Crystal system	amorphous
Chemical composition	varies, but is usually rich in carbon and hydrogen
Variety	acrylic
Trade names	plastic, acrylic, polymer
Color	all colors
Transparency	from transparent to opaque
Luster	waxy to vitreous
Optical phenomena	asterism (simulation), adularescence, aventurescence, chatoyancy, orient (simulation), iridescence, color change
Refractive Indices	usually between 1.460 to 1.700
Optic character	SR, ADR strong and strain colors common
Birefringence	none
Dispersion	unavailable
Pleochroism	none
Flourescence	varies
Absorption spectra	not diagnostic
Specific gravity	1.05 to 1.55
Fracture	conchoidal to irregular, with dull to vitreous luster
Cleavage	none
Identifying characteristics	bubble gas Inclusions, flow lines, mold marks, "orange peel" effect, concave facets, rounded facet junctions, warm to touch, often acrid odor to hot point, light heft
Possible treatments	unknown
Possibly mistaken with	glass, jet, black coral, tortoise-shell, amber, opal, turquoise, bone, ivory
Hardness	1.5 - 3

STABILITY

Reaction to heat	melts or burns at low temperatures
Stability to light	stable
Reaction to chemicals	attacked by many chemicals, surface may be dulled

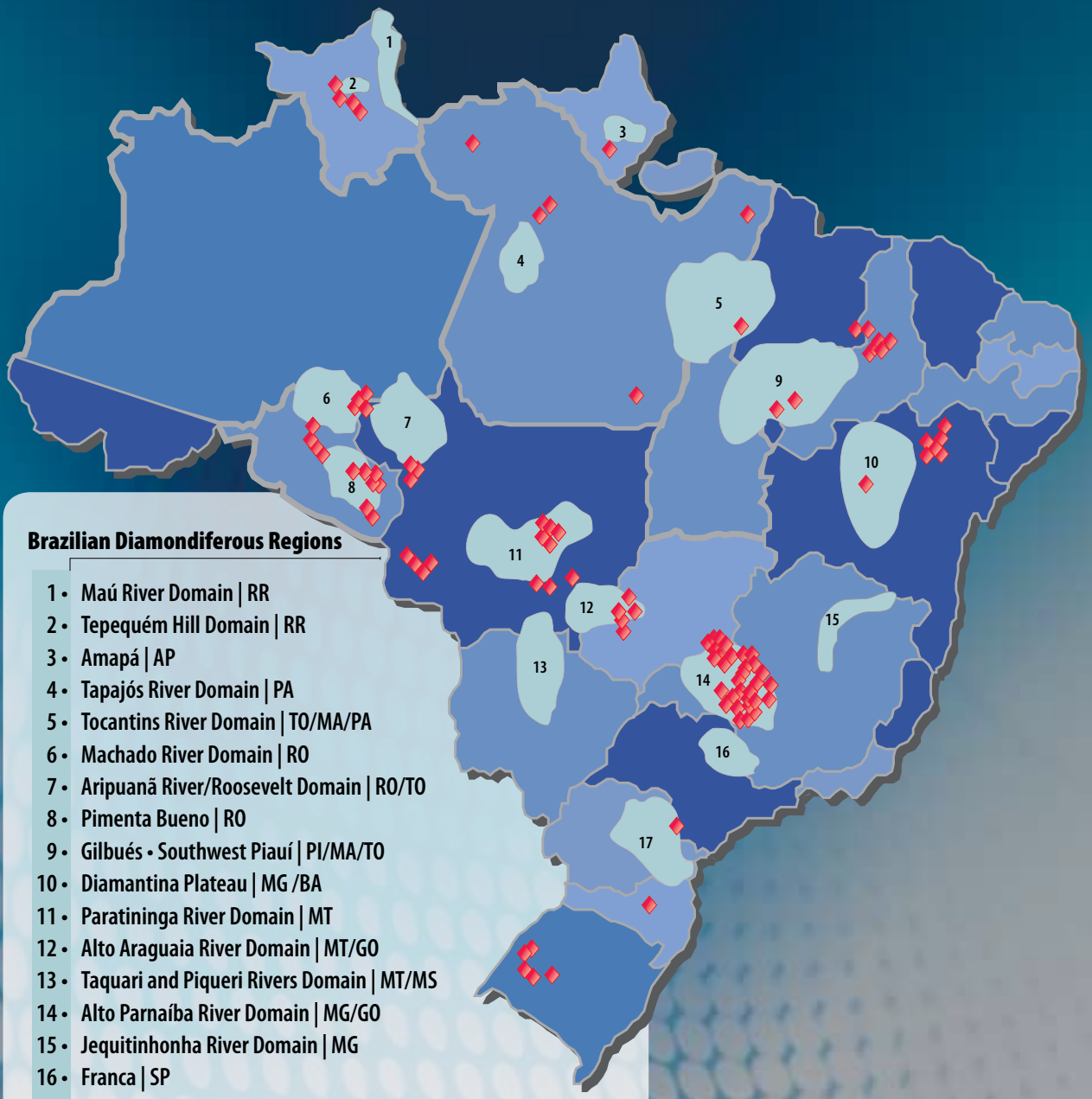
SUBJECT INDEX

The index includes designations and varieties of the gems used in the trade. Bold pages present the most relevant information

ATTACHMENTS

ATTACHMENT I BRAZILIAN MAPS

DIAMONDIFEROUS



Brazilian Diamondiferous Regions

1 • Maú River Domain | RR
2 • Tepequém Hill Domain | RR
3 • Amapá | AP
4 • Tapajós River Domain | PA
5 • Tocantins River Domain | TO/MA/PA
6 • Machado River Domain | RO
7 • Aripuanã River/Roosevelt Domain | RO/TO
8 • Pimenta Bueno | RO
9 • Gilbués • Southwest Piauí | PI/MA/TO
10 • Diamantina Plateau | MG /BA
11 • Paratininga River Domain | MT
12 • Alto Araguaia River Domain | MT/GO
13 • Taquari and Piqueri Rivers Domain | MT/MS
14 • Alto Parnaíba River Domain | MG/GO
15 • Jequitinhonha River Domain | MG
16 • Franca | SP
17 • Tibagi River Domain | PR

Kimberlites

SOURCE: DNPM / 2009


Colored Gems
Agate
Amethyst and Quartz
Aquamarine
Chrysoberyl
Emerald
Garnet
Malachite
Opal
Spodumene
Topaz
Tourmaline
SOURCE: DNPM / 2009

ATTACHMENT II NATURAL GEMOLOGICAL MATERIALS

The natural materials of gemological interest is divided in the following designations: **Natural Gems, Organic Substances, Fossils and others**.

It follows below the current list with gemstones usually cut for jewelry purposes or kept in rough state, indicated by an apostrophe after the name - Ex: Almandine[1] - for the varieties considered commercially relevant. It is also presented a list of organic substances, fossils and others.

NATURAL GEMS

MINERAL	VARIETY
Actinolite[1]	Nephrite[1]
Adamite	
Afrisite (Schorl)	
Albite	Cleavelandite
	Peristerite
Algodonite	
Allanite	
Almadine[1] (garnet)	Star Almandine[1]
Amblygonite	
Amphibole	
Analcime	
Anatase	
Andalusite[1]	Chiastolite
Andradite[1]	Demantoid[1], Melanite
Anhydrite	
Antigorite	Bowenite
Apatite[1]	Cat's-Eye Apatite
Apophyllite	
Aragonite	Ammolite
Augelite	
Australite (rock)	
Axinite	
Azurite	Azurmalachite
Baddeleyíte	
Barite	
Bayldonite	
Benitoite	
Beryl[1]	Aquamarine[1]
	Emerald[1]
	Goshenite
	Green Beryl[1]
	Heliodore[1]
	Morganite[1]
	Red Beryl
Beryllonite	
Bismutotantalite	
Boleite	
Boracite	
Bornite	

MINERAL	VARIETY
Brazilianite[1]	
Breithauptite	
Brookite	
Bustamite	
Calcite	Cobalt Calcite
	Marble
Canasite	
Cancrinite	
Cassiterite	
Celestite or Celestine	
Ceruleíte	
Cerussite	
Chabazite	
Chalcedony[1] | Quartz Cryptocrystalline Variety	Agate[1]
	Agate with Inclusions[1]
	Chrysoprase[1]
	Cornelian or Carnelian[1]
	Heliotrope[1]
	Jasper[1]
	Onyx[1]
	Sard
	Sardonyx[1]
Chambersite	
Charoite	
Childrenite	
Chondrodite	
Chromite	
Chrysoberyl[1]	Alexandrite[1]
	Cat's-eye[1]
Chrysocolla[1]	
Chrysotile	
Cinnabar	
Clinochlore	Kammererite
Clinozoisite	
Cobaltite	
Colemanite	
Columbite	
Cordierite (Iolite)[1]	

MINERAL	VARIETY
Corundum[1]	Color Change Sapphire[1]
	Padparadscha or Pink-Orange Sapphire[1]
	Ruby[1]
	Sapphire[1]
	Star Ruby[1]
	Star Sapphire[1]
Covellite	
Creedite	
Crocoite	
Cryolite	
Cuprite	
Danburite	
Datolite	
Diamond[1]	
Diaspore	
Dickinsonite	
Diopside[1]	Chromo-Diopside[1]
Dioptase	
Disthene (Kyanite) [1]	
Dolomite	
Dravite (Tourmaline)[1]	
Dumortierite	
Ekanite	
Elbaite (Tourmaline)[1]	Achroíte[1]
	Bicolor Tourmaline[1]
	Indicolite[1]
	Polychromatic Tourmaline[1]
	Rubellite[1]
	Siberite
Enstatite	Chrome-Enstatite
Eosphorite	
Epidote[1]	
Euclase[1]	
Euxenite	
Feldspar[1]	
Fergusonite	
Fluorite[1]	
Friedelite	
Gadolinite	
Gahnite	
Garnet[1]	
Gaylussite	
Grandidierite	
Grossular[1]	Hessonite[1]
	Tsavorite[1]
Gypsum	Alabaster
Hambergite	
Hauyne	
Hematite[1]	Specularite[1]
Hemimorphite	
Herderite (Hydroxylherderite)	
Hodgkinsonite	

MINERAL	VARIETY
Holtite	
Howlite[1]	
Hureaulite	
Hypersthene	
Idocrase (Vesuvianite)	Californite
Inderite	
Iolite (Cordierite)[1]	
Jade (Jadeite) [1]	Chloromelanite
Jade (Nephrite)[1]	
Jeremjevite	
Kornerupine	
Kurnakovite	
Kyanite	
Kyolite	
Labradorite[1]	Spectrolite[1]
Langbeinite	
Lapis lazuli[1] (rock)	
Lawsonite	
Lazulite	
Lazurite	
Legrandite	
Lepidolite	
Leucite	
Liddicoatite	
Linarite	
Lizardite (rock)	Verde Antico or Verd-Antique (rock)
	Williamsite
Ludlamite	
Magnesite	
Magnetite	
Malachite[1]	Azurmalachite
Manganotantalite	
Marcasite[1]	
Meliphanite	
Mellite	
Microcline	Amazonite[1]
Microlite	
Milarite	
Millerite	
Mimetite	
Moldavite[1] (natural glass)	
Monazite	
Montebrasite	
Mordenite	
Nambulite	
Natrolite	
Nepheline	Eleolite
Nickeline	
Obsidian[1] (natural glass)	
Oligoclase	Aventurine[1]
	Sunstone[1]
Olivine (Peridot)[1]	Chrysolite[1]
Opal[1]	Opal[1](several varieties)

MINERAL	VARIETY
Orthoclase	Moonstone[1]
Painite	
Palygorskite	
Pectolite	
Pentlandite	
Periclase	
Peridot (Olivine) [1]	Chrysolite[1]
Perovskite	
Petalite	
Phenakite	
Phosgenite	
Phosphophyllite	
Pollucite	
Prehnite	
Prosopite	
Proustite	
Pumpellyite	
Purpurite	
Pyrite[1]	
Pyrope[1]	
Pyrophyllite	
Pyroxene	
Pyroxmangite	
Quartz[1]	Amethyst[1]
	Aventurine[1]
	Bicolor Quartz [1]
	Cat's-Eye Quartz [1]
	Citrine[1]
	Hawk's-Eye[1]
	Morion[1]
	Prase[1]
	Quartz with inclusions [1]
	Rock Crystal [1]
	Rose Quartz [1]
	Smoky Quartz [1]
	Star Quartz [1]
	Tiger's-Eye[1]
Realgar	
Rhodizite	
Rhodochrosite[1]	
Rhodonite[1]	
Rutile	
Samarskite	
Sarcolite	
Saussurite (rock)	
Scapolite[1]	
Scheelite	
Schlossmacherite	
Schorl (Afrisite)	
Scorodite	
Scorzalite	
Senarmontite	
Sepiolite	

MINERAL	VARIETY
Serandite	
Serpentine[1]	
Shortite	
Siderite	
Silica Glass (natural)	
Sillimanite	
Simpsonite	
Sinhalite	
Smaltite	
Smithsonite	
Soapstone	Agalmatolite (rock)
	Steatite (rock)
Sodalite[1]	
Sogdianite	
Spessartine[1]	Malaia[1] or Malaya[1]
Sphalerite	
Sphene (Titanite)[1]	
Spinel[1]	Ceylonite
Spodumene[1]	Hiddenite[1]
	Kunzite[1]
	Triphane
Staurolite	
Stibiotantalite	
Stichtite	
Strontium Kyanite	
Sulfur	
Taaffeite	
Talc	
Tantalite	
Tausonite	
Thaumasite	
Topaz[1]	Imperial Topaz[1]
Tourmaline[1]	
Tremolite	
Tugtupite	
Turquoise[1]	
Ulexite (rock)	
Unakite (rock)	
Uvarovite	
Vanadinite	
Variscite, Sabalite or Trainite	
Vesuvianite (Idocrase)	Californite
Villiaumite	
Vivianite	
Wardite	
Wavellite	
Whewellite	
Wilkeite	
Willemite	
Witherite	
Wollastonite	
Wulfenite	
Xenotime	

MINERAL	VARIETY
Zincite	
Zircon[1]	

MINERAL	VARIETY
Zoisite	Tanzanite[1]
	Thulite

ORGANIC SUBSTANCES, FOSSILS AND OTHERS

Amber
Ammonite
Bone
Copal
Coral
Cultured Pearl
Horn
Ivory
Jet
Mother-of-Pearl
Odontolite
Operculum
Pearl
Tortoise-Shell
Vegetable Ivory

ATTACHMENT III SYNTHETIC GEMS, ARTIFICIAL GEMS AND PRODUCTS

The following lists present the most frequently found in Brazil:

ARTIFICIAL GEMS
Cubic Zirconia (Zirconium Dioxide)
Fabulite (Strontium Titanate)
GGG (Gadolinium Gallium "Garnet")
Linobate (Lithium Niobate)
Lithium Tantalate
Minkovite (Yttrium Silicate)
YAG (Yttrium Aluminium "Garnet")

SYNTHETIC GEMS
Aquamarine
Alexandrite
Calcite
Cat's-Eye Alexandrite
Chrysoberyl
Corundum
Diamond
Emerald
Fluorite
Jadeite
Lapis lazuli
Moissanite
Opal
Periclase
Peridot
Quartz (colorless and colored)
Red Beryl
Ruby
Rutile
Sapphire
Scheelite
Sodalite
Spinel
Star Ruby (Asteriated Ruby)
Star Sapphire (Asteriated Sapphire)
Tourmaline
Turquoise

PRODUCTS

COMPOSITE GEMS
Double Gem (doublet)
Triple Gem (triplet)

COATED GEMS
Coral
Diamond
Emerald
Ivory
Lapis lazuli
Opal
Pearl
Ruby
Sapphire
Topaz
Turquoise

IMITATIONS
Glass
Plastic
Porcelain

RECONSTRUCTED GEMS
Amber
Coral
Ivory
Lapis lazuli
Turquoise

ATTACHMENT IV MINERALOGICAL GROUPS AND MINERAL SPECIES

The following mineralogical groups and mineral species are considered of gemological interest:

AMBLYGONITE GROUP
Amblygonite
Montebrasite
Natromontebrasite

AMPHIBOLE GROUP
Actinolite
Ferro-actionolite
Hornblende
Pargasite
Tremolite

APATITE GROUP
Fluorapatite
Mimetite
Pyromorphite
Vanadinite

ARAGONITE GROUP
Aragonite
Cerussite
Strontianite
Witherite

BARITE GROUP
Anglesite
Barite
Celestine or Celestite

BENITOITE GROUP
Bazirite
Benitoite
Pabstite

CALCITE GROUP
Calcite
Magnesite
Rhodochrosite
Siderite
Smithsonite

DOLOMITE GROUP
Ankerite
Dolomite
Kutnohorite
Minrecordite
Norsethite

EPIDOTE GROUP
Allanite
Clinozoisite
Epidote
Hancockite
Piedmontite
Zoisite

FELDSPAR GROUP
Albite
Andesite
Anorthite
Anorthoclase
Bytownite
Celsian
Hyalophane
Labradorite
Microcline
Oligoclase
Orthoclase

GARNET GROUP
Almandine
Andradite
Grossular
Hydrogrossular
Kimzeyite
Knorringite
Pyrope
Schorlomite
Spessartine
Uvarovite
Yamatoite

HEMATITE GROUP
Corundum
Hematite

MARCASITE GROUP
Marcasite

OLIVINE GROUP
Fayalite
Forsterite
Tephroite

OSUMILITE GROUP
Milarite
Osumilite
Sogdianite
Sugilite

PYRITE GROUP
Pyrite

PYROXENE GROUP
Acmite
Augite
Clinoenstatite
Clinohypersthene
Diopside
Enstatite
Hypersthene
Jadeite
Spodumene

RUTILE GROUP
Cassiterite
Rutile

SCAPOLITE GROUP
MARIALITE
Meionite

SODALITE GROUP
Hauyne
Lazurite
Nosean
Sodalite

SPHALERITE GROUP
Sphalerite

SPINEL GROUP
Chromite
Franklinite
Gahnite
Galaxite
Hercynite
Magnesiochromite
Magnetite
Spinel

TEKTITE GROUP • NATURAL GLASS (PROBABLY FORMED BY METEORITIC IMPACT)
Australite
Moldavite

TOURMALINE GROUP
Buergerite
Chromdravite
Dravite
Elbaite
Ferridravite
Liddicoatite
Schorl
Tsilaisite
Uvite

TURQUOISE GROUP
Turquoise

VARISCITE GROUP
Mansfieldite
Scorodite
Strengite
Variscite

ZEOLITE GROUP
Analcime
Chabazite
Gmelinite
Heulandite
Mesolite
Natrolite
Pollucite
Scolecite
Stilbite
Thomsonite
Yugawaralite

CONTACTS

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DNPM • NATIONAL DEPARTMENT OF MINERAL PRODUCTION

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